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INFORMATION REPORT INFORMATION REPORT

CENTRAL INTELLIGENCE AGENCY

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COUNTRY	USSR	REPORT	[redacted]
SUBJECT	Soviet Technical Manuals and Documents Dealing With Aircraft, Radar, and Miscellaneous Technical Equipment	DATE DISTR.	14 November 1960
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SOURCE EVALUATIONS ARE DEFINITIVE. APPRAISAL OF CONTENT IS TENTATIVE.

[redacted] Russian- and English-language manuals [redacted] 25X1

1. Samolet AN-2 (The AN-2 Aircraft). This manual was published in Moscow in 1959 by the State Publishing House of the Defense Industry for the Ministry of Defense, USSR. It consists of 62 pages of text, diagrams, and tabular data. The manual presents instructions for the use of aviation, electrical, and radio equipment of the AN-2. It was not classified by the Soviets.

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												SAC	X

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4. The IL-28 Aircraft with VK-1A Engine; Manual for the Operation and Technical Servicing. This manual was published in English in Prague, in 1957. Its 333 pages of text, drawings and tabular data present information on such operations as pre- and post-flight inspections, refueling, maintenance of the fuselage, engines and the various components and systems, and transportation of the aircraft. It was classified SECRET by the Czechs.

5. Instruktsiya po Raschetu Dalnosti i Prodolzhitelnosti Poleta Samoleta Yak 18U c Dvigatelem M-11FR i Vintom V-501-D81 (Instructions for Calculation of Range and Duration of Flight of the Aircraft Yak-18U with the M-11FR Engine and the V-501-D81 Propeller). The booklet was published for the Directorate of the Commander-in-Chief of the Air Forces by the Military Publishing House of the Ministry of Defense USSR, in Moscow, in 1957. It contains 19 pages of text, tables and charts. It was marked "Not for Sale" but was not classified by the Soviets. Unfortunately, much of the book was photographed out-of-focus.

6. Aircraft Firing Sight ASP-3P; Technical Description. This document was published in English, in Prague in 1957. It consists of 129 pages of text, drawings, photographs, tables, and equations. Main subjects presented include principles of operation, design, and instructions for use. It was classified SECRET by the Czechs, but the SECRET stamp was subsequently painted over.

7. Tekhnicheskoye Opisaniye i Instruktsiya po Ukladke i Ekspluatatsii Parashyuta S-2 (Technical Description and Instructions for Packing and Use of the S-2 Parachute). The booklet was printed in 1956, but no other publication data are given. It bears order number 81-3000 and the letter-number combination G 21054. It has 65 pages of text and drawings. The booklet was photographed out of focus and much of it is illegible.

8. Tekhnologiya Vypolneniya Reglamentnykh Rabot na Vertolete Mi-4 (Technology for Performing the Regulatory Work on the MI-4 Helicopter), compiled by B. D. Kirichenko, N. A. Lisitskiy, and N. V. Budanov, and published by the Directorate of the Commander-in-Chief of the Air Forces, Military Base No. 77, in 1957. It was not for sale, but was not classified by the Soviets. The manual was photographed out of focus, and much of it unfortunately is illegible. It consists of 228 pages.

9. UVP-I Rod-Type Bomb Fuze Control; Description, Operating and Maintenance Instructions. It was published in English, but no other publishing data are given. It contains 15 pages of text, drawings, and photographs. The booklet describes the various types of UVP-1 bomb fuze control and how to use them. It was not classified.

10. Glide Path Receiver GRP-2. It was published in English, in Prague, in 1957. No other publishing data were given. The booklet contains 81 pages of text, drawings and tables devoted to describing the receiver and its components and explaining how it should be serviced and operated. It was not classified by the Czechs.

11. Avtomobilnaya Kislorodnogo-Zaryadnaya Stantsiya "AKZS-40"; Opisaniye i Instruktsiya po Obsluzhivaniyu i Ekspluatatsii (Automobile Oxygen-Charging Station "AKZS-40"; Description and Instructions for Service and Use). The booklet was printed for the Ministry of Machine Building USSR; no other publishing data are given. It consists of 114 pages of text, drawings, and tables. It was not classified by the Soviets.

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12. Impulsnyy Sinkhroskop, Tipa SI-1; Opisaniye i Instruktsiya po Ekspluatatsii (Impulse Synchroscope, Type SI-1; Description and Instructions for Use). It was printed in 1958; no other publishing data are given. The booklet consists of 44 pages of text, diagrams, and tables and an electrical flow chart. It was not classified by the Soviets.

13. Dublikat Formulyara, Dvigatelya Tip ASh-62ir, Seriya 13 No. LS 13056 (Duplicate Logbook, Engine Type ASh-62ir, Series 13, No. LS 13056). No publishing data are given. The book consists of 304 pages, mostly of blank forms to be filled in as the engine is used, inspected, and repaired. Duplicate blank pages were not photographed. Also included are 14 rating booklets (pasport) used to record events in the operation and maintenance of components of the engine, together with a 30-page pamphlet entitled Tekhnicheskoye Opisaniye Generator Tipa GSK 1500 (Technical Description of the Generator Type GSK 1500) which was found in the pocket of the rear cover of the logbook and is being treated as part of document No. 13. None of these materials were classified by the Soviets.

14. Testing Set П-ЗП-317 for Checking Sight I- ПС -163. The booklet was published in English, but there are no other identifying data. It contains 24 pages of text and diagrams on the design, care, and use of the set. It was not classified.

15. PES-15B Mobile Power Station. This manual was published in English, in Prague, in 1957. No other publishing data are given. It devotes 38 pages of text, diagrams, and tables to a description of the station and its components and how to operate, maintain and repair both the station and its components. A 47-page appendix on the GAZ-MKB engine deals with the technical aspects of the engine's construction and its servicing. It was classified SECRET by the Czechs, but the SECRET stamp was subsequently painted over.

16. Radiolokatsionnaya Stantsiya P-20; Rukovodstvo po Remontu, Albom I Prilozheniy (Radar Station P-20 /TOKEN/; Repair Handbook, Album 1 Appendix). This manual consists of 104 pages plus 18 large sheets of wiring diagrams. All of the material is presented in diagram and tabular form. All of the significant publishing data were obliterated. It was classified SECRET by the Soviets.

17. Nazemnyy Radiolokatsionnyy Zaproschik NRZ-1 - Albom Prilozheniy k Rukovodstvu po Remontu (The NRZ-1 /FISH NET/ Ground Radar Interrogator - Album Supplement to the Repair Handbook). This manual consists of 127 pages of diagrams and tabular data. The Soviets classified this document SECRET. All significant publishing data were obliterated.

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AIRCRAFT FIRING SIGHT
ASP - 3P

Technical description

PRAGUE 1957

AIRCRAFT FIRING SIGHT
ASP - 3 P

TECHNICAL DESCRIPTION

I. DEFINITION AND PURPOSE OF THE SIGHTING DEVICE.

The firing sight ASP-3P is intended for sighting during the firing from a gun mounted in the rear gun turret IL-K 6 of the bomber 11-28.

The firing sight automatically corrects for angular deviations due to the relative displacement of the target, while following it closely, as well as deviations due to the lag of a projectile and the lowering of its trajectory.

The angular corrections in the sighting device are produced in accordance with the range of fire, the angles of the turned gun to the longitudinal axis of the firing plane, its speed and altitude of flight with the ballistic data given.

The range rheostat of the sight ASP-3P is marked with an abbreviation of the type of gun (NR-23) for which it is designed.

The interconnection with the gun ensures the parallel positioning of the sighting head's mechanical axis to the gun's axis at all turns of the gun. The angular corrections produced by the device are transferred to a mobile grid, visible in the filed of vision of the sight, which deviates (when closely following the target plane) from its mechanical axis (the gun's axis) by a total angular deviations depending on the firing parameters, taken into account by the sighting device.

Thus the angle produced between the gun's axis and the line of sight of the target plane, passing through the centre point of the sighting grid, corresponds to the total angular correction.

When using the sight ASP-3P the gunner sees the target through a semi-transparent mirror in the sighting head collimator system; thus in addition to the plane aimed at, he also sees in the field of vision the range finder circle, formed by sight small rhombs the centre point and the constant diameter circle (Fig. 1)

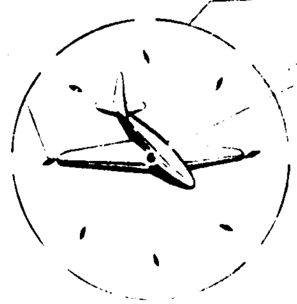


Fig. 1. The sighting device field of vision

The constant diameter circle is used with the gyroscope arrested (the sight's line of wight is rigid with respect to the axis of the gun) in order to hit a quickly manoeuvring target when large angular speeds are need or to fire at a range outside the scope of the sighting device automatical mechanism, as well as when the gyroscope is is out of order.

In addition the sight is equipped with a mechanical sight, which is used as a substitute in case the gyroscope or the electric illumination fails to work.

Unlike other sights used in revolving turrets, which compelled the gunner, during firing to estimate the distance and the foreshortening of the target by eye and to ascertain the sighting-point on the scale of the grid, operations with the sight ASP-3P are reduced to a minimum, i.e. closely following the target with the centre point and at the same time framing it with the range-finder circle.

II. BASIC DATA FOR THE SIGHT

1) TACTICAL - TECHNICAL DATA

a) Tactical data

The sight is calculated for the following ranges of the individual parameters :

1) Range of fire	180 + 800 m
2) Plane of own velocity	300 + 900 km/h
3) Altitude	1000 + 14000 m
Gun lock angles (azimuth)	0 + 360°

5) Gun angle of elevation	30 + =80°
6) Dimension of target (base)	7 - 45 m
7) Diameter of mechanical sight circle...	132 thous.dist.
8) Largest angle of lead	8°

b) Electrical data

1) The sight is supplied with direct current from the electrical power supply having a voltage of	27 V ± 10%
2) Input power not exceeding	120 W
3) The sight is equipped with a carbon voltage regulator which maintains the voltage on the main parts of the sight within..	22 ± 0,75 V
4) Motor DG-2 :	
output on the shaft	1,8 W
revolutions per minute	5200 rev/m
Full load current	0,4 A ± 10%
5) Electric lamp	22 V, 12 W

c) Optical data

1) Focal length of objective	180 mm
2) Clear diameter of objective	46 mm
3) Eyepupil distance from semi transparent mirror (measured along optical axis)...	250 mm (maxim).
4) Angular diameter of the range-finders circle varies within	17,5 to 122 thous dist.(from 60 -To-70°)
5) Angular diameter constant diameter circle	132 thous dist.

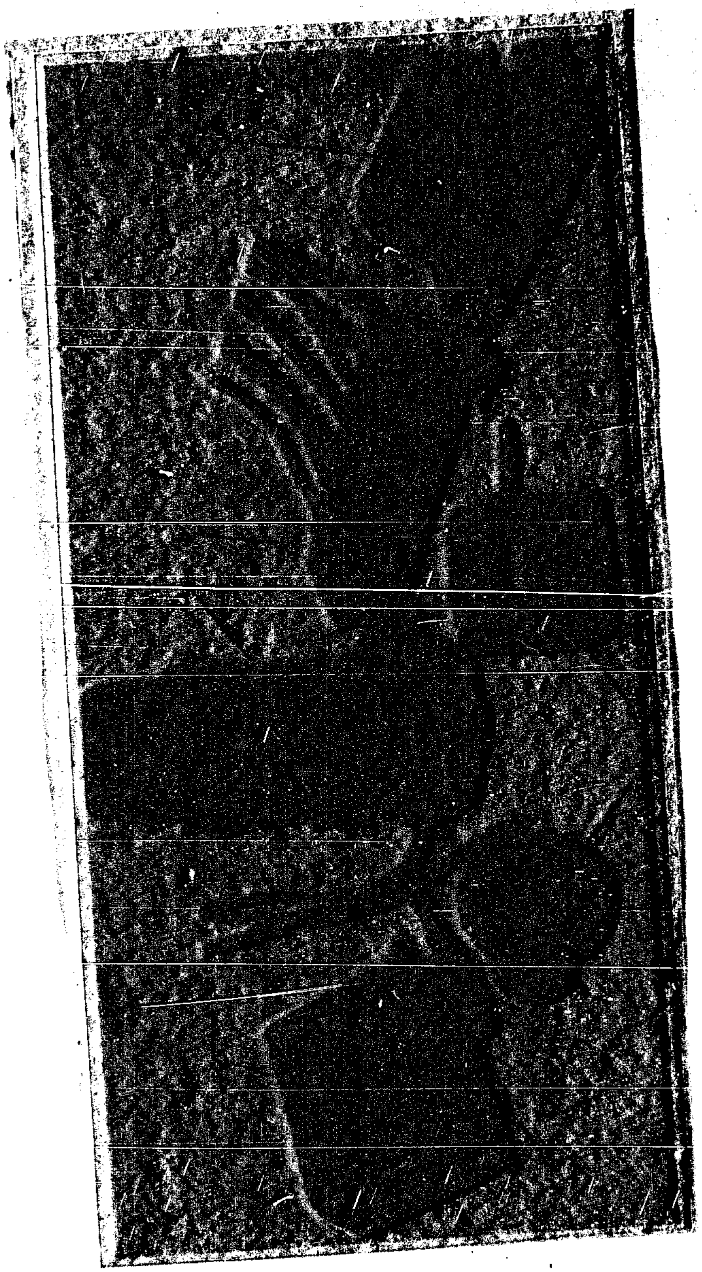
2) COMPLETE SIGHT

The complete sight consists of the following parts:

MAIN PARTS:

Sighting head with range rheostat 1	1 piece
Computing mechanism 2	1 "
Speed mechanism 3	1 "
Altitude mechanism 4	1 "
Junction box 5	1 "
Voltage regulator 6	1 "
Radio interference suppressor	1 "

Fig.No.2-...page 4



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SPARE PARTS :

Lamps 22 V, 12 W	4 pieces
Semi-transparent mirror	1 "
Light-filter	1 "
Spring belt	1 "
Silicagel (in hermetic packing	50 g
TOOLS	
Screw-driver 0,8 x 6 mm	1 piece
Spanner 9 x 11 mm	1 "
Tool for chahging silicagel	1 "
Wire for changing silicagel	1 "
Screw-driver for removing drier	1 "
ACCESSORIES	
Case	1 piece
Napkin 200 x 200 mm	1 "

III. PRINCIPLE OF OPERATION OF THE SIGHT

1) FORMULAE SOLVED BY THE SIGHT

a) Diagram of firing

Whem firing from guns mounted in revolving turrets of bombers fitted with sights,based on the principle of the relative angular velocity of the target (while following it closely), it is necessary to take into account the relative displacement of the target, the lag and the lowering of the projectile.

In the sight ASP-3P the necessary corrections are produced automatically according to the range of fire,its own velocity,angles of the gun to the longitudinal axis of the plane and the altitude.

The angler corrections,produced on correct sighting,set the sight line of sight into such a position to its mechanical axis (the gun axis) that the projectile fired from the gun,and the target plane reach the point of lead at the same time(i.e. to ensure the target being hit by the projectile fired)

Fig. 3 shows the diagram of aerial fire in a relative coordinate system for the case that the bomber and the target are flying on the same level.

The diagram contains the following notation

- initial velocity vector of the projectile;

Fig.No 3 - page 6

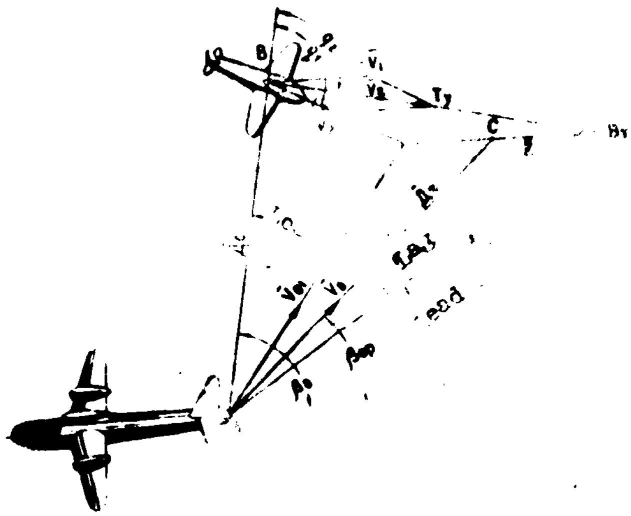


Fig.3. Diagram of aerial fire

D_1 - point of lead;
v_1 - velocity vector of the bomber ;
v_2 - velocity of the target plane ;
v_r - relative velocity vector of the target plane;
D_o - radius vector of the target at the moment of firing ;
$_o$ - deck angle of the target, corresponding to the range D_o ;
D_r - radius vector of the target in the direction of the projectile initial velocity ;
D_{1d}- radius vector to the point of lead in the relative coordinate system (in the coordinate system connected with the bomber).
$_{1d}$- deck angle of the target, corresponding to the lead distance;
 - deck angle of the gun at the moment of firing ;
 - vector of lag of the projectile ;
z
$_{1d}$-angle of lead in the relative coordinate system ;
Qr -course angle of the target in the relative coordinate system;
T_{1d}-time of flight of projectile to lead distance ;
Q_o -course angle of the target in the absolute coordinate system.

+

The diagram does not include the angular correction for the lowering of the projectile in its trajectory (angle of sight) which lies vertical plane.

b) $-_{1s}$- angular correction for the lag of the projectile;

b) Calculation of the relative displacement of the target.

Let us consider the diagram of aerial fire for the case that the bomber and the target are flying on the same level, assuming straight line constant velocity flight of the target during the flight of the projectile.

We will deal with the base where at a certain moment the revolving turret of the bomber is in the point A (Fig.3) and the target in point B.

The bomber is flying with constant velocity v_1 its axis including an angle with the line of sight AB, while target is flying with constant velocity v_2 its axis including an angle q_o with the line of sight AB.

The axis of the gun barrel is directed along the vector v_o and forms an angle with the longitudinal axis of the bomber.

If we consider both the motion of the target and that of the projectile relative to the firing plane, we can, on condition that the projectile must hit the target they are to meet at a certain point B_{1d}, called point of lead, or future position determine the expression for the angle of lead-

Solving the triangle AB_{1d} we can write

$$\frac{v_r \quad T_{1d}}{\sin \quad {}_{1d}} = \frac{D_{1d}}{\sin 180^\circ \quad q_r}$$

or, since sin /180° - q_r/ equals sin q_r,

$$\sin \quad {}_{1d} = \frac{v_r \sin q_r}{D\ 1d} \quad T_{1d} \tag{1}$$

Multiplying and dividing the right side of equation by D_o, we obtain

$$\sin \quad {}_{1d} = \frac{v_r \quad \sin \quad q_r}{D_o} \quad \frac{D_o}{D_{1d}} T_{1d} \tag{2}$$

From Fig.3 it is evident that the expression $\frac{v_r \sin q_r}{D_o}$ is nothing but the relative angular velocity of the target Do.

$$\sin \quad {}_{1d} = \frac{Do}{D_{1d}} T_{1d} \tag{3}$$

Substituting

$$\frac{D_o}{D_{1d}} T_{1d} = T \tag{4}$$

we obtain

$$\sin \quad {}_{1d} = \quad {}_o T \tag{5}$$

For small angles sin $_{1d} = {}_{1d}$, Equ. (5) fot the angle of lead can therefore be rewritten as follows : (6)

$$_{1d} = {}_{o}T$$

From the theory of aerial fire the expression for time T_{1d} of the projectile flight through a distance D_{1d} in the absolute system of coordinates is

$$T_{1d} = \frac{D_{1d}}{f_n/C_{1o}\ D_{1d}/V_{o1}} \qquad (7)$$

Knowing the distance D_r in the relative coordinate system, Equ. (7) will assume the form :

$$T_{1d}\ \frac{n\ D_r}{f_n(L_n\ n\ D_r\ nv_o)} = \frac{n\ D_r}{nfn\ (C_nD_rV_o)} = \frac{D_r}{f_n(C_nD_rV_o)} \qquad (8)$$

where $n = \frac{Vo}{Vo}$

The coefficient n can be taken out and placed in front of the function f_n due to the fact that the average velocity is practically a homogeneous function.

Substituting the value T_{1d} from Equ.(8) into Equ-(4) we obtain

$$T = \frac{D_o}{D_{1d}} = \frac{D_r}{f_n(C_nD_rV_o)} = \frac{D_o}{f_n\ (C_nD_rV_o)}\ \frac{D_r}{D_{1d}} \qquad (9)$$

Taking $\frac{D_r}{D_{1d}}$ 1, i.e. D_r D_{1d}, we finally obtain an expression fot the time T, introduced into the sighting device :

$$T = \frac{D_o}{f_n\ (C_nD_rV_o)} \qquad (10)$$

Thus, the formula fot the angle of lead in the sight ASP-3P assumes the form: (6)

$$_{1d} = \ T$$

where $_o$ is thr angular velocity of the line of sight, equal to the angular velocity of the target (while following it closely with the centre point) at the moment of opening fire;

T is the time introduced into the sight, depending on the distance D, altitude N and other parameters.

The form of Equ (6) for the angle of load does not alter if we assume a different law for the motion of the target and only the expression for the time T is subject to a change.

c) Calculation of the lag of the projectile

When considering the flight of the projectile in the relative coordinate system (system of coordinates connected with the bomber), we must take into account the lag of the projectile, which is due to the effect of the component of the air resistance. The lag vector has a direction opposite to the velocity vector of the bomber.

From the theory of aerial fire we know that the lag vector z is determined from the formula

$$Z = - v_1 \left/ T_{1d} - \frac{D_r}{V_o} \right/, \qquad (11)$$

where z is the lag vector;

v_1 - is the velocity vector of the bomber

D_r - is the radius vector of the target in the direction of the vector V_o ;

T_{1d} - is the time of flight of the projectile through the lead distance.

As was shown above, T_{1d} is determined in the relative coordinate system using the formula :

$$T_{1d} = \frac{D}{f_m\ (Ch\ D_r\ V_o\ )} \qquad (8)$$

From the theory of the aerial fire it is also known that the average velocity $f_m(Ch\ D_r\ V_o\ )$ of the projectile can be expressed with sufficient precision by the expression

$$f_m\ (Ch\ \ D\ \ V_o) = V_o - k\ \ (n\ \ V_o\ )\ Ch\ D_r$$

Equ.(8) can thus be rewritten to

$$T_{1d} = \frac{D_r}{V_o - K\ (n\ \ V_o\ )\ C_h\ D_r}$$

where k (nv) is a coefficient depending on the direction of fire.

Substituting the value T_{1d} into Equ.(11) we obtain an expression for the magnitude of the lag vector

$$Z = - V_1 \frac{D_r}{V_o - K(n\ V_o)\ C_h\ D_r} - \frac{D_r}{V_o} = \frac{V_1}{V_o}$$

$$\frac{K(\ n\ V_o\ (\ C_h\ D_r^{\ 2}}{V_o - K(n\ V_o)\ C_h\ D_r} \quad \text{or} \quad Z = \frac{V_1}{V_o}\ K\ (n\ V_o)\ C_h\ D_r\ T_{1d}$$

Substituting for reason of design k_{av} for $K(n\ V_o)$ and C_o for C_h we obtain

$$Z = \frac{V_1}{V_o}\ K\ av\ \ C_o\ \ T_{1d}\ \ D_r\ . \qquad (12)$$

From the triangle ACB_{1d} (see Fig.3) we can write down the expression of the angular correction for lag of the projectile

$$\frac{Z}{\sin \quad _{1g}} = \frac{D_{1d}}{\sin (180^{o} - \quad _{g})}$$

or ,as $\sin (180^{o} - \quad _{g}) = \sin \quad _{g})$

$$\sin \quad _{1g} = \frac{Z \sin \quad _{g}}{D_{1d}} \qquad (13)$$

Since for small angles $\sin \quad _{1g} \quad _{1g}$ Equ-(13) can be written in the form

$$_{1g} = \frac{Z \sin \quad _{g}}{D_{1d}} \qquad (14)$$

Substituting the value Z from Equ.(12),we obtain a formula for determining the angular correction for the lag og the projectile

$$= \frac{V_{n}}{V_{o}} K_{av} \quad C_{o} T_{1d} \sin \quad _{g} \frac{D_{r}}{D_{1d}} \qquad (15)$$

In this form however,Equ.(15) cannot be realized in the sighting device for reason of design.

In order to incorporate Equ.(15) in the design of the sighting device ASP-3P,it is necessary to find the angles corresponding to the projections of the lag vector on the axes x, y, axes perpendicular to the axis of the gun (the sight axes) since the production of the lag angle in the sight can only accomplished by deviating the axis of the gyroscope by means of two pairs of coils,placed on the vertical and horizontal pole-pairs of the magnet system.

In order to simplify the determination of the projection of the vector V_{1} on the axes x, y (Fig. 4) :

$$V_{o} = - V_{1} \cos (90^{o} - q) = V_{1} \sin q \qquad (16)$$
$$V_{1d} = - V_{1} \cos q \cos (90^{o} + \quad) = V_{1} \cos q \sin$$

Since the vector z is opposed to the vector V_{1}, its projection on the axis x,y, will be as follows

$$Z_{x} = Z \sin q \qquad (17)$$
$$Z_{y} = - 2 \cos q \sin$$

The angular correction on the axes x,y, will therefore be

$$\sin \quad _{1d} \text{hor} = \frac{Zx}{D_{r}} \qquad (18)$$
$$\sin \quad _{1d} \text{vert.} = \frac{Z y}{D_{r}}$$

Since the largest angles of lag do not exceed 5°, this can be written, using equation (17) as follows

$$lg\ \text{hor} = \frac{Z \sin q}{D_r} \qquad (19)$$

$$lg\ \text{vert} = - \frac{z \cos q \sin}{D_r}$$

Substituting for Z the value from Equ.(12), we obtain working formulas for the angular corrections in the direction of the horizontal and vertical axis of the sighting device:

$$\text{hor.} = \frac{V_1}{V_o} K_{av} \Delta C_o T_y \sin q \qquad (20)$$

$$\text{vert.} = - \frac{V_1}{V_o} K_{av} \Delta C_o T_y \cos q \sin$$

The minus sign in the second equation shows that the angle of lag lg vert must be directed downwards for elevation of the gun sun upwards for its depression.

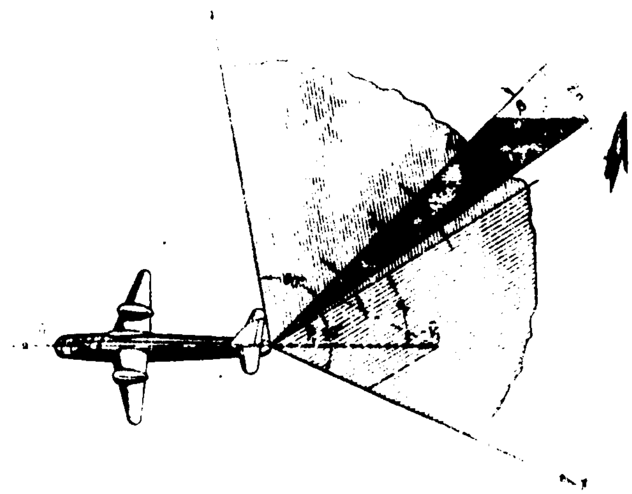


Fig.4. Calculation of the projectile lag

The angular corrections for the lag in the sight ASP-3P are produced according to the formula (20).

Instead of T_{1d} the value T, determined by Equ.(10) is introduced into the sight.

In this way the angle of lag produced in the sight will depend on the plane's own velocity, the altitude of flight, range of fire and the angles q, , which determine the position of the gun.

d) Calculation of the lowering of the path of the projectile.

Due to the forces of gravity during fire the trajectory of the projectile is lowered. The calculation of the lowering in the sight ASP-3P is accomplished by the provision of the sighting-angle.

From the theory of aerial fire we know that the sighting angle is determined by the equation

$$_{ol} = D_{ld}\, F_n\, (C_h\, D_{ld}\, V_{ol}\,)\ \cos \qquad (21)$$

where D_{ld} - is the absolute distance of the point of lead;

V_{ol} - is the absolute initial velocity of the projectile ;

 - is the angle of elevation of the gun ;

F_n - is a function, given in ballistic tables.

The angle of sight provided in the sight ASP-3P corresponds to the case of the fire from the rear turret during the attack of a fighter having a velocity $V_{fg} = 1,2\ V_{bomb}$ for an average altitude H = 4000 m and velocity of the bomber amounting to 200 m/sec. Thus the magnitude of the angle of sight depends merely on the distance D_o and angle of elevation of the gun .

2-. PRINCIPLE OF THE FORMATION OF THE SIGHTING DATA.

a) Formation of the angle of lead

The mechanism intended to produce angular corrections for the relative displacement of the target (angle of lead) must solve the following dependences.

$$_{ld} = {}_o\ T \qquad (6)$$

where $_o$ = angular velocity of the line of sight equal to the relative angular velocity of the target (while closely following it) at the moment of opening fire ;

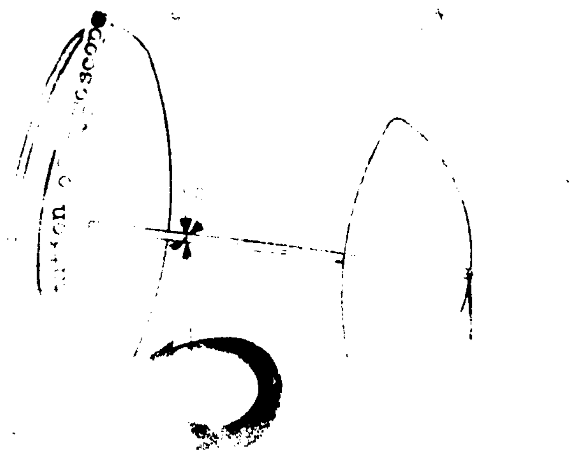
T = predetermined time, introduced into the sighting device.

This dependance is solved in the sight ASP-3P by means of a gyroscopic mechanism that produces a certain angle as a function of the values $_o$ and T.

The gyroscopic device consists of two assemblies an electromagnetic assembly having four poles and the rapidly spinning gyroscope, which is supported by a universal joint.

The relative angular velocity of the target is measured with a gyroscopic rate of turn indicator which has the following properties of a three-stage gyroscope :

1. The axis of the rapidly spinning gyroscope tends to maintain its position in space;
   if we apply an external force P to the rapidly spinning gyroscope, its axis will precess in a plane perpendicular to the direction of the applied force /Fig.5/.



[illegible] its [illegible] external [illegible] force.

[illegible] force [illegible], [illegible] axis, [illegible] turn the axis of the [illegible] perpendicular to the [illegible] in the [illegible] xoz as shown by the arrow which is [illegible] plane yoz, in which the force acts.

The axis of the gyroscope will rotate with a certain angular velocity. g. This motion of the axis turn/ under the influence of the external force is called a p r e c e s s i o n of the gyroscope. The angular velocity of the precession of the axis of the gyroscope equals

$$g = \frac{M}{H}$$

[illegible] - moment of the force P with respect to the point C.

N - a quantity depending on the design of the gyroscope, i.e. its mass, dimensions, velocity of its spin. N is called the moment of momentum or angular momentum. The angular momentum in the given design is a constant.

Thus $\quad g = \frac{R}{H} \; P = KP$,

where K is a constant.

From what has been pointed out it is evident that with a constant P, which has an arbitrary value, the velocity of the precession of the gyroscope axis will be constant, too.

If P varies g will also vary depending on the value of P. This dependence is used in order to produce the angle of lead.

THE OPTICAL FEATURES OF THE SIGHT.

Fig. 6-shows the optical features of the sighting device. The section is in a vertical plane of symmetry and so the axis AA of the gyroscopic mechanism is also shown in this diagram.

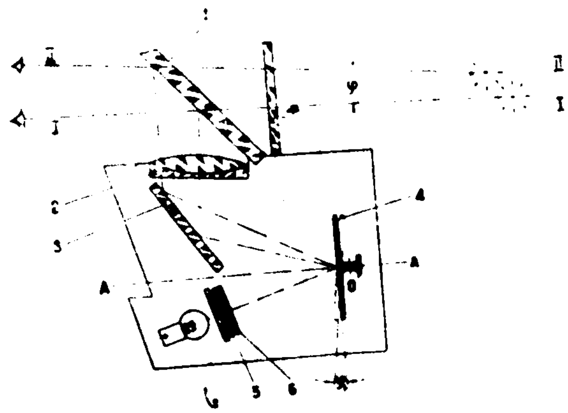


Fig. 6. Optical diagram of the sight.

The objective 2, mirror 3, plates of the grid 5 and 6, as well as the semi-transparent mirror 1 are placed at the correct angles with respect to the axis AA, these angles remaining unchanged throughout the operation of the sight.

The mirror 4 is only perpendicular to the axis AA for the case of zero angular velocity of precission g . In this case the image of the grid, visible to the operator's eye, will be seen in the direction I-I, parallel to AA.

On the appearance of g the mirror will rotate on the axis of

the gyroscope round the point O, which is the fulcrum of the gy-
oscope. The axis of the gyroscope will now form some angular
eviation with the axis AA. Consequently the image of the grid
ill not be observed in the direction I-I, but in a new direction
I-II.

The direction in which the gunner will see the grid, i-e.the
direction of the line of sight will therefore depend on the direc-
tion of the axis of the gyroscope perpendicular to which the mirror
4 is fixed. This mirror 4,unlike the mirror 3,is called movable.

The design is executed innsuch a way as to maintain in general
the direction of the gyroscope axis and theline of sight,they re-
maining parallel only in case of zero angular deviation between
the axis AA and the gyroscope axis.If the axis of the gyroscope
forms some angular deviation with AA,the line of sight will form
an angle with the direction I-I. The ratio of these angles is
given by —— 0,7

Thus the line of sight rotates through a smaller angle than the
axis of the gyroscope.

The above description of the optical features of the sight and the
behaviour of the movable mirror 4 explains how the connection bet-
ween the movement of the axis of the gyroscope and the line of
sight is accomplished.

The relation —— 0,7 which reduces the displacement of the
line of sight serves to introduce a certain amount of damping. In
this way the sighting process is facillitated and the influence of
sudden turns of the plane (as well as that of the gyroscope axis
is modified.

It is necessary to pint out that the ratio 0,7 called COEFFICIENT
OF DAMPING, depends on the value of the angle 1 and the plane,in
which it lies.

Fig.6 shows an example of the rotation of the gyroscope axis and
subsequently also of the movable mirror in a vertical plane,i.e.
in the plane of the drawing. An analogous displacement of the line
of sight takes place if the turn is performed in a horizontal pla-
, i.e. perpendicularly to the plane of drawing,or if a composite
. . sum of both turns is performed. In all these cases the

deviation of the line of sight is subject to one rule - it always turns in the same direction as the axis of the gyroscope.

FUNCTIONING OF THE GYROSCOPIC ASSEMBLY WHEN FORMING THE ANGLE OF LEAD

Let us assume that the gyroscope is switched on, i.e. rotated by the motor. Imagine that in the first moment the axis of its rotor coincides with the axis AA. An alluminium cup fixed to the axis of the gyroscope cuts each of the four magnetic fluxes with the same linear speed since the axis of its rotation coincides with the axis AA. The breaking forces acting on the cup, do not therefore develop a resultant force P and the axis of the gyroscope will not precess.

If however the axis AA is rotated in some arbitrary plane, the axis of the gyroscope tending to maintain its position in space unaltered, will produce an angular deviation $_1$ with the axis AA.

In this case the cup will cut the four magnetic fluxes with different linear speeds. A resultant force P will be acting on the axis of the gyroscope, will produce a precession which will pull it towards the axis AA. If the axis AA remains stationary in the new turned position $_g$ will diminish, since $_1$ diminished and also P will grow smaller, till the axis of the gyroscope again coincides with AA. The whole system will return to the original position. Between the axis AA and the axis of the gyroscope a connection exists as a result of the four magnetic fluxes which tends to return the axis of the gyroscope to coincide with the axis AA. This tendency is the greater the larger the angle , and decreases as the angle diminishes.

If the line of sight is to form with the gun axis an angle , ( ). - angle of lead , (see Fig.13) must be equal to Let us determine which conditions have to be fulfilled in the desion of the gyroscope for this equation to hold.

Since $= {}_{sl}\, T$ where $_{sl} = \omega_o$ - angular velocity of the line of sight and T is the time, introduced into the sight, the following equattion must hold $= {}_{sl}\, T$ and since $\frac{}{} \; 0{,}7$ then

$$= \frac{1}{r} \; _{sl}\, T .$$

$_{sl} = {}_g$, this formule will assume the form $= \frac{1}{0{,}7}\, _g\, T.$

Let us consider this formula together with $\varepsilon = \frac{K_T}{(I\,W)^2}\ \omega g$

It is evident that if these two expressions are to be equal the equation $\frac{K_s}{(IW)^2} = \frac{1}{0,7}\ T$ must be valid.

Solving for I, we obtain $I = \frac{K}{T}$

where K is a new constant including all other constants (K_5 from the previous formula, the number of turns in the magnetizing coil W, ____ - 0,7.

Only by observing this condition will the angular deviation of the line of sight be equal to the angle of lead.

The value of T varies according to the distance of the target D and the altitude of flight, and also depends on the projectile ballistics and other circumstances.

After choosing the gun, that is to say determining the projectile characteristics and making number of other assumptions for additional conditions, we find that in order to produce an angle of lead, the current I entering the gyroscopic assembly must be a function of the range and the altitude.

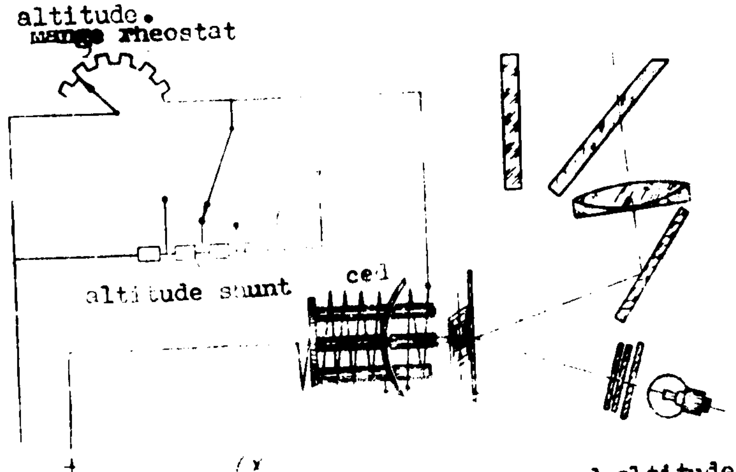


Fig. 7. Diagram of introduction of distance and altitude.

This equation only holds for a constant angle = const. As a matter of fact, $_g$ differs from $_{sl}$ by a value proportional to the rate of change of the angle during the following of the target, i.e.

$= {}_{sl} - 0,4\ \frac{d}{dt}$. Hence also the necessity of continuously win the target for a certain time (1 second at least) with uninterrupted framing of the same.

\- - - - - - - - - -

If we connect into the electrical circuit in series with the lead coil C_{ld} (Fig.7) the range rheostat R_{rd}, the resistance of which is calculated according to the law $R = A\sqrt{T}$ and if the slider of the rheostat is set proportional to the range a change in the range of fire will result in a corresponding change of the connected resistance. With $A = \frac{u}{K}$ the current passing through the lead coil will vary according to the law

$$I = \frac{u}{R} \quad \frac{u}{A\sqrt{T}} \quad \frac{K}{\sqrt{T}}.$$

The change of current will also entail a change of the magnetic flux; of the braking effort P_b as well as of the angle of deviation of the gyroscope.

The rheostat, the resistance of which is calculated in accordance with the law $R = A\sqrt{T}$, is called the range r h e o s t a t .

If the slider of the range rheostat is to be set to the required angle, a mechanism must be provided in the sight which will determine the range of the target and will thus automatically determine the current to be passed through the gyroscopic assembly. This mechanism is provided and consists of an external base range-finder which is coupled to therange rheostat.

We know that the angle at which the eye sees the target diminishes as the distance increases and, vice versa, increases as the distance diminishes (Fig.8. This angle is called a PARALLACTIC ANGLE and is denoted by γ. From the Fig.8 it is evident that

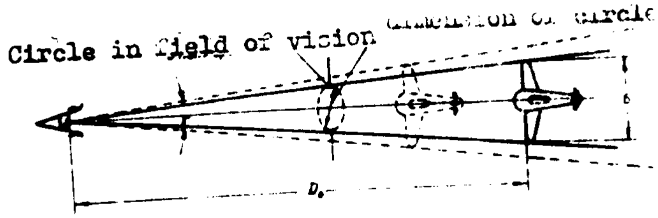
$$\operatorname{tg}\frac{\gamma}{2} = \frac{B}{2\,D_0}\ \text{. or}\ = \underline{B\ 1000}\ \text{thous.dist.}$$

where B - dimension of target in meters (wing span) ;

D - initial distance of target in meters.

With constant dimension of the target the value of the angle γ will vary with the range .

Let us imagine the field of vision to contain a series of circles of different sizes, the parallactic angles of which correspond for a certain dimension of the target B to definite ranges D. If we ...scribe the target into one of these circles, knowing to which ... this circle corresponds, we can find the range of the target ... Targets can vary in size, however. In this case we



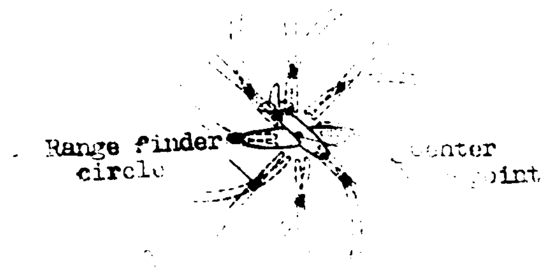


Fig.8. Change of the parallactic angle according to the target distance

can inscribe in one and the same circle different targets that are at different ranges E.g. we can inscribe in circle, the parallactic angle of which = thousandts of dist., bases of 15,20,35 m at ranges equalling respectively 150, 200 and 350 m :

$$= \frac{15}{150} = \frac{20}{200} = \frac{35}{350} = 0{,}1 \text{ radians} = \text{thous.dist.}$$

It would be necessary then, to mark each circle in the field of vision with the base and range it is meant for.

It is clear that it is better to possess one circle having variable diameter (with a variable parallactic angle). Such a circle is provided in the range-finder mechanism.

In the focal plane of the objective 2 (see Fig.1) two glass plates 5,6 are located. The plates themselves are not transparent and let the light pass through slits made in an opaque layer. Both plates contain a transparent point in their centres. The plate 5 carries eight straight rays at angles of 45^{0}, the plate 6 eight spiral rays, also under an angle of 45^{0}. Placing the two plates together so as to make the two centre points coincide and passing a light through them by means of a lamp, we obtain eight little shiny rhombs, placed at equal distances from the centre point. When turning one of the plates with respect to the other, the rhombs will either converge to the centre or diverge. If we locate the plane of contact ... plates in the focal plane of the objective we shall see in the collomator's field of vision eight little rhombs, their inner ends forming a circle, the diameter of which can be altered by turning one or the other plate.

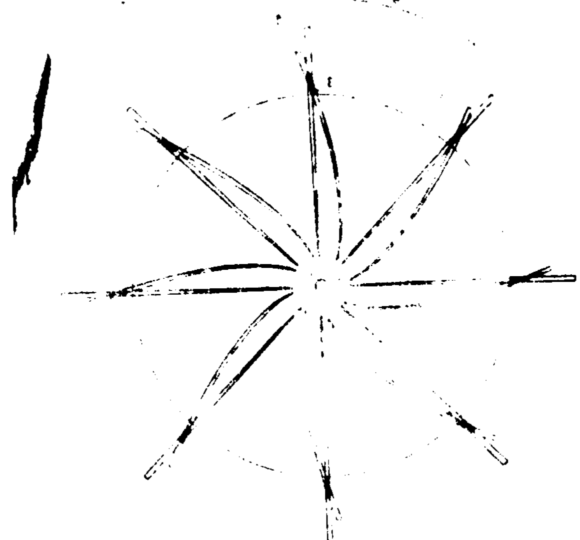
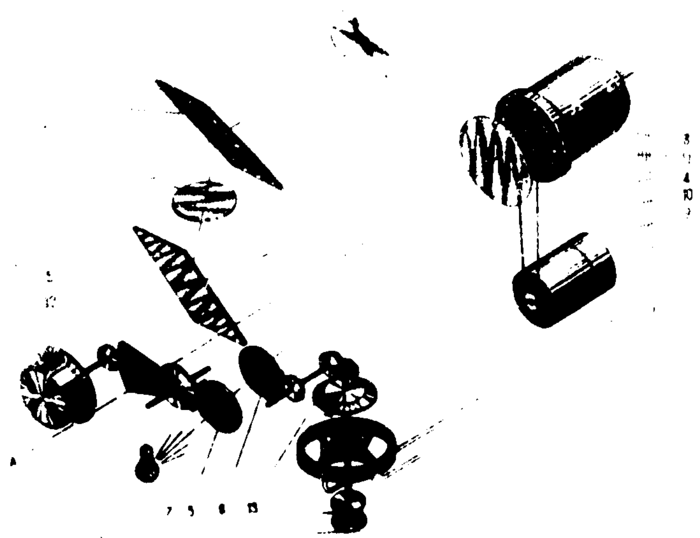


Fig. 9. Diagram of the range-finder circle.



... of the sighting head with the ran...

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Fig. 9.shows the centre point and little rhombs,formed by the spiral and straight rays. It is known,that if the plate is located in the focus of the objective and γ is the parallactic angle, at which we see the inner points of the rhombs E, it holds that

$$\operatorname{tg}\frac{\gamma}{2} = \frac{OE}{f}$$

where F is the focal length of the objective.

The value OE will vary with varying angle which is the angle of rotation of two plates against each other. OE is the radius vector logarithmic of the spiral AB,on which the point E is situated. It is the radius of the circle formed by the rhombs. With the alternation of the angle the point E will approach the centre or move away from it,while the radius OE will diminish or increase; since

$$= \frac{B}{D_0}$$

,we obtain after taking the logarithm

$$\lg \gamma = \lg B - \lg D_0 ,$$

i.e. the angle of turning of one plate against the other is proportional to the difference of the logarithms of the base B and the distance D_0. This means that to each combination of l_g B and l_g D_0. there corresponds a value of i.e. a radius OE vector, a diameter of their circle and a parallactic angle for the given B and D_0.

From Fig.10 it can be seen that the plate 5 with straight slits is rotated by means of a train of gears from the circular dial of bases 12,which is marked proportional to log B (with regard to the course of the target 1(4). The plate 6 with the spiral slits is rotated from the circular dial of ranges,which is marked proportional to log D.

Each plate is rotated independently from its dial and transmission alternating in general the angle between the plates in every position of the dials B and D. Thus a circle consisting of eight little rhombs is obtained,the parallactic angles of which are equal to those under which a target is visible having a base adjusted on the dial of bases and at a range equal to that adjusted on the dial of ranges.

This is the basic principle of the external base range-finder.

The shaft of the bevel gear rotating the plate 6,is joined to the spindle of the range rheostat. Thus to a certain range there corresponds a certain position of the rheostat and the refore also certain position of the sliding contact on the turns of the resistance rheostat is calculated in such a way that in every position of the contact the current passing through the coil, corresponds to the range adjusted on the dial.

The current is calculated from the formula $I = \frac{V}{T}$

where T corresponds to the distance adjusted on the dial.

Since $I = \frac{u}{R}$, we get $\frac{K}{\sqrt{T}} = \frac{u}{R}$ or $R = \frac{u}{K}\sqrt{T} = A\sqrt{T}$.

This formula enables us to calculate the general resistnace of the computing circuit for every range and thus also the variable resistanc of the rheostat.

The introduction of time T into the computing mechanism can be imagined as follows : the gunner catches eight of the target, according to its type be adjusts on the dial of bases the target size and by rotating the range control he inscribes the target into the circle formed by the inner ends of the eight rhombs. Doing this he automatically adjusts the sliding contact of the range rheostat to the correct range at which the target is situated, i.e. he introduces a certain resistance into the lead coil. This introduces into the gyroscopic assembly a current corresponding to the time T, which is calculated from the range and the gun mounted in the plane.

By the above simple operation the gunner adjusts the range of the target and introduces the time of flight of the projectile T automatically into the gyroscopic assembly.

The altitude of flight is taken into account by altitude resistors which are switched into the electrical circuit of the lead coil (see Fig. 7), shunting the range rheostat. By means of a switch the required resistor corresponding to the correct altitude is switched into the circuit changing the current in the coil to a value necessary for establishing the change of the time of flight of the projectile at the changed altitude. The change of the current results in a change of the magnetic flux a change of the braking force and consequently a change in the angle of deviation of the gyroscope. If all parameters mentioned above are introduced into the gyroscopic mechanism, the axis of the gyroscope will deviate from its original position through an angle proportional to the angle of lead, .the gyroscope will solve the required dependence ⁄ = ⁄ ·T.

The transferin of the angle of deviation of the gyroscope into the gunner's filed of vision is carried out in the sight by the optical system, the mechanism of which has been thoroughly dealt with.

The mirror 4 (see Fig.10), forming part of the gyroscope optical system, is fixed to the shaft of the gyroscope 8. For a deviation of the mirror through an angle the grid 5,6 visible in the field of vision, will deviate through an angle = o T.

Besides the range-finder circle the field of vision also contains a circle of constant diameter 14. The gunner thus sees in the field of vision a centre point and two circles, one of which is formed by a dashed line circle of constant diameter, the other by the eight little rhombs of variable diameter.

The illumination of the sight grid is accomplished by an electric lamp.

Since the range-finder grid is in the focal plane of the objective its image coming from the objective and being reflected by the semi-transparent mirror is projected into infinity. The gunner, observing the target through the semi-transparent mirror, sees the range-finder circle formed by eight little rhombs, as well as the constant diameter circle on the background.

If the gyroscope axis coincides with the mechanical axis of the sight, the mirror 4 reflects the beam so that the image of the circles and of the centre point appears in the centre of the field of vision.

The location of the gyroscope mirror with respect to the plates and the objective is chosen in order that the angle of deviation of the gyroscope axis from its original position may exceed the angle of deviation of the sight-line, i.e.

where -is the angle of deviation of the sight line ;
-is the angle of deviation of the gyroscope axis ;
-is the coefficient of damping.

b) Formation of the angle of lag

If the lag of the projectile is to be taken into account the line sight must rotate through angles of horizontal and vertical lag. formation of the angle of lag is accomplished in the sight by gyroscope axis by means of two couples of coils, placed on the vertical and horizontal poles of the magnetic system.

We will call these coils supplementary as distinct from the main lead coil.

By means of two horizontal coils a horizontal lag correction is carried out. Two vertical coils serve for the vertical correction of lag.

The respective pairs of coils are connected in series so that the fields produced by each coil of the pair are in opposition.

The coils K are shunted by variable resistor R_{12}. The variable resistors R_{11} and R_{20} being connected to this parallel connection.

The position of the sliding contacts of the potentiometers R_{12} and R_{11} is varied according to the plane own velocity v.

The position of the sliding contact of the potentiometer R_{20} is adjusted according to the altitude of flight N.

The resistor R_{13}, connected parallel to the coils K and the series resistor R_{14}, are compensating resistors.The current in the vertical supplementary coils,intended for obtaining the vertical angles of lag,is produced by an analogous circuit.

c) Formation of the angle of sight.

The lowering of the projectile flight due to gravity is accounted for by forming the angle of sight.

The deviation of the gyroscope axis through an angle proportional to the angle of sight,is obtained by the interaction of the magnetic fields formed by the main coil and the coils of sight. The windings of the coils of sight are located on top of the vertical lag correction coils.

The angle of deviation of the gyroscope axis depends on the relative intensities of the currents,passing through the supplementary and main coils.

The voltage applied to the bridge,is varried by the range rheostat R_3.

The rheostat of the lead and sight circuits are essentially mounted on a common frame. On one half of the frame a rheostat of lead circuit is wound,while the second half carries the rheostat of the sight circuit.

The bridge consists of two branches. The upper branch contains constant resistances S, the lower the potentiometer R_1 .

The coils of sight are connected into the diagonal of the bridge, th ends of which are joined to the centre point of the bridge upper branch and to the sliding contact of the potentiometer R_1.

The voltage across the diagonal is proportional to the voltage applied to the bridge and to the shift of the sliding contact of the potentiometer from the centre position.

The adjustment of the current, passing through the coils of sight to a prescribed value is accomplished by the compensating resistor R_{13}

3) MAIN CIRCUIT DIAGRAM OF THE SIGHT.

Let us deal with the main circuit diagram of the sight as shown in Fig. 26.

The sight is fed from the board power with a voltage of 27 V ± 10% through the switch K, fuse F and the radio interference suppressor.

The radio interference suppressor connected into the circuit of the sight serves to suppress interference from switching, which is produced in the sight and which would interfere with the operation of the aeroplanes radio station. After the filter a voltage regulator produces a stabilised voltage of 22 ± 0,75 V. Connected in front of the voltage regulator is an electric lamp L for illuminating the range-finder grid together with the rheostat f_1 for regulating the intensity of the light, a heater, consisting of three windings O_1, O_2, O_3, a thermoregulator T, a relay R and heaters of the mirror O_m and of the lens O_{ob}.

The heater serves to compensate the temperature error of the sight, which is due to the influence of the fluctuations of temperature on the specific resistance of gyroscope cup and on the resistance of the electromagnetic correction coils. The heater winding is placed in the body of the gyroscopic mechanism. The body also includes a thermoregulator which serves to maintain a constant temperature of + 50° in the gyroscopic mechanism. If the temperature rises above + 50°, the thermoregulator disconnects the circuit of a relay, which breaks the circuit of the heater.

To prevent the optics from becoming misty a special heater on the stationary mirror O_n and the objective O_{ob} is provided. It acts by means of heat evolved by a layer of metal deposited on the surface of optical details. The circuit of this heater is continually ected with the sight switched on.

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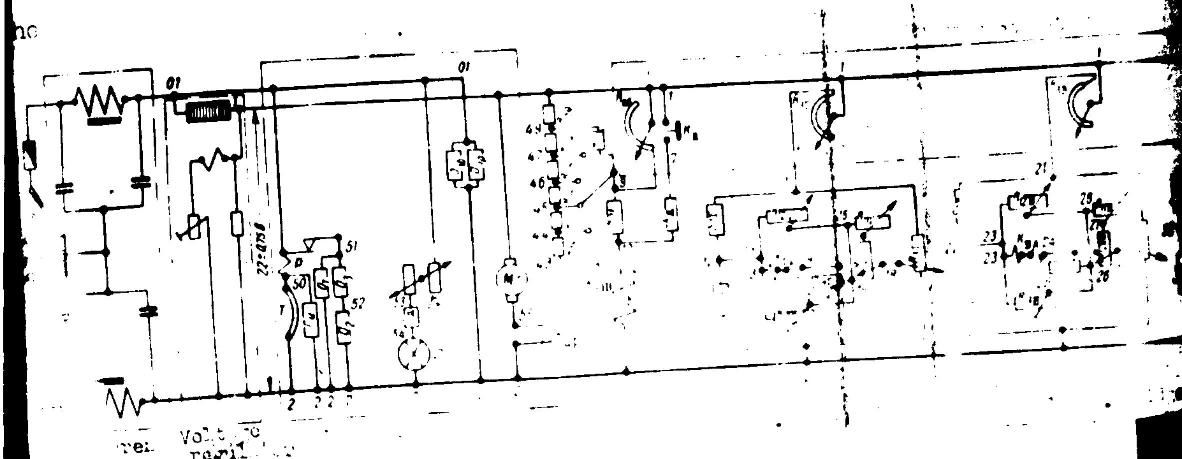


Fig.11. Main circuit diagram of the sight.

The motor M driving the gyroscope, is supplied with a stabilised
t re. A contact K_{ar} connected in series with the motor serves to
connect the motor circuit, if the gyroscope is arrested (see chapt.
page).

The lead circuit is joined to the line of stabilised voltage
± 0,75 V. It consists of the lead coil C_{1d}, the range rheostat R_{o3}
and constant resistors R_{o1},
itude shunts R_{o4}, R_{o5}, R_{o6}, R_{o7}, R_{o8}
, R_{1o} .

Parallel to the range rheostat the damping button circuit is connected into the lead circuit.

If the damping button is depressed a very strong current passes through the lead coil, permitting the gyroscope to deviate only insignificantly.

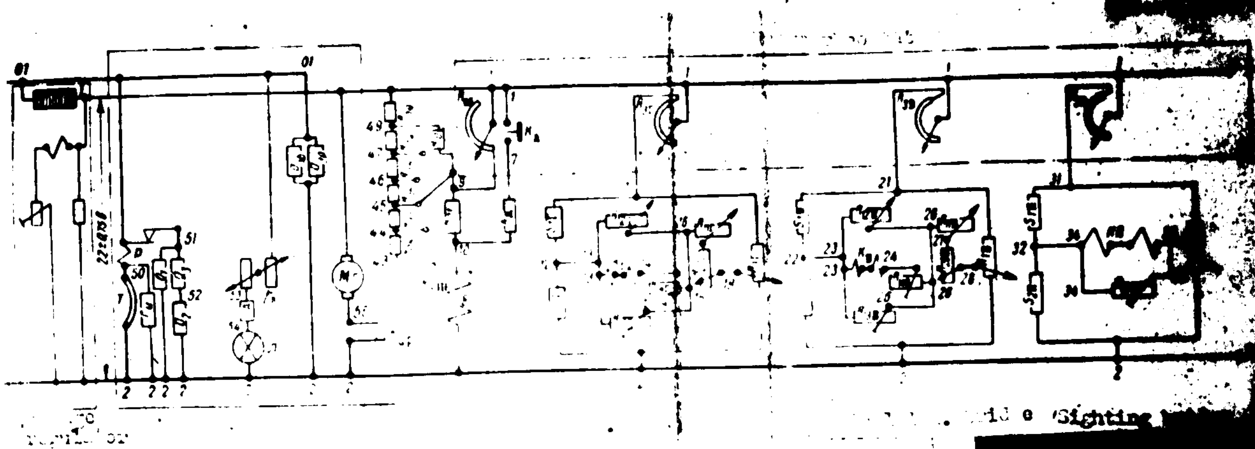
As a consequence of this the sight grid, visible in the field of vision, will become more rigidly connected with the sight and even sudden turns of the sight will deviate only insignificantly.

The electrical computing circuits for lag and sighting are also connected to the line of stabilised voltage.

4.) MECHANICAL DEVICES FOR PRODUCING TRIGONOMETRIC FUNCTIONS.

...otion of the sliding contact of the potentiometers R_1 shown ... circuit diagram must be proportional to $\sin\theta$ / $\cos\theta$ for the ... bridge, to cos ... for the sighting bridge.

the sight switched on.



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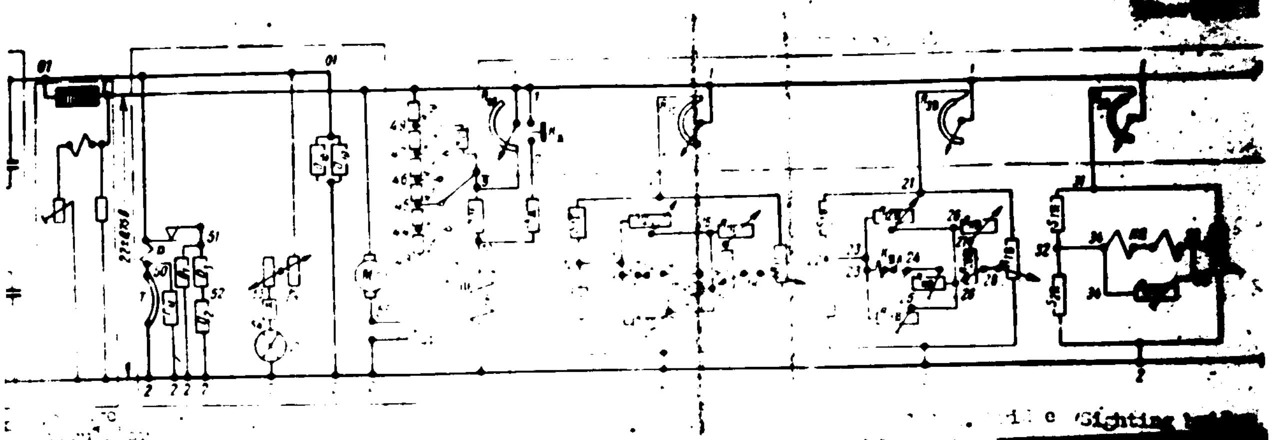
CHANICAL DEVICES FOR PRODUCING TRIGONOMETRIC FUNCTIONS.

sliding contact of the potentiometers R_1 shown

must be proportional to sin q for the

for the sighting bridge.

:h the sight switched on.



11. Main circuit diagram of the sight.

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contact K_{ar} connected in series with the motor serves to
the motor circuit,if the gyroscope is arrested (see chapt.
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circuit is joined to the line of stabilised voltage
. It consists of the lead coil C_{ld}, the range rheostat R_{o3}
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damping button is depressed a very strong current passes
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nsequence of this the sight grid,visible in the field of
l become more rigidly connected with the sight and even
turns of the sight will deviate only insignificantly.
rical computing circuits for lag and sighting are also
the line of stabilised voltage.

MECHANICAL DEVICES FOR PRODUCING TRIGONOMETRIC FUNCTIONS.

sliding contact of the potentiometers R_1 shown
must be proportional to sin θ for the
for the sighting bridge.

To obtain motions the sliding contacts of the respective potentiometers R_1 are actuated by means of special mechanical devices.

a) Obtaining the value sin q.

Fig.12 gives the kinematic diagram of the device

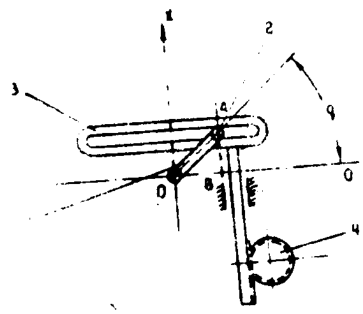


Fig.12).Kinematic diagram of the sine device.

The crank 1 rotates through an angle q, equalling the deck angle of the gun; the angles are measured from the direction OO. The pin 2, sitting on the crank, fits into the slot on the linkplate 3. The link-plate is moved in the guide parallel to the axis Ox.

A rack on the li-plate engages the gear wheel 4. The rotation of the gear wheel 4 is transfered to the sliding contact of the potentiometer R_1 which turne through the same angle.

From Fig. 27 if follows that when turning the crank through the angle q the rack moves through the distance AB where

$$AB = r \sin q$$

where r = length of crank.

If the gear wheel 4 engages the rack in such a way that the centre position of the sliding contact of the potentiometer corresponds to zero position of the crank, then the value of sin q can be introduced into the horizontal lag bridge by means of this mechanism.

b) Obtaining the value cos q.

In order to obtain the value cos q the same mechanism can be used except for measuring the angless from the axis Ox (Fig.12).

The position of the crank along the axis OX must correspond to the centre position of the potentiometer sliding contact.

When turning the crank through an angle q the lin-plate moves through a distance proportional to cos q and consequently the sli-

-ding contact of the potentiometer turns from its initial position in the centre of the potentiometer through a value proportional to cos .

In this way the sliding contact of the potentiometer R_1 will move in a manner necessary to obtain the angles of sight.

c) Obtaining the product cos q sin .

The product cos q sin can be obtained by means of a mechanism, a drawing of which is shown in Fig.13 and 14

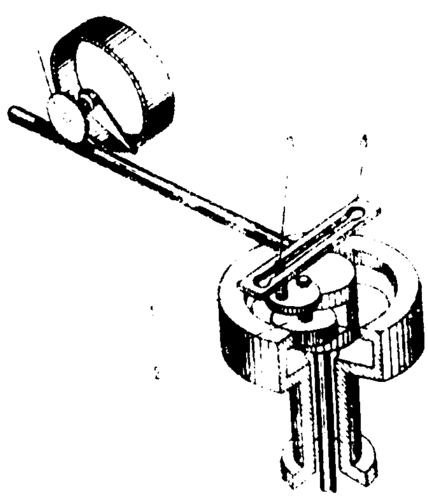


Fig.13. Kinematic diagram of the device for producing cos q sin

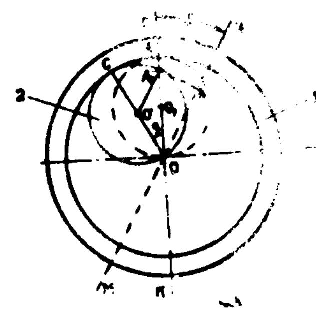


Fig.14. Producing cos q sin

The internal gear wheel 1 rotates through an angle . Meanwhile the gear wheel 2, which engages wheel 1, turns together with it as a single whole. Apart from this, gear wheel 2 can rotate through an angle q, running along wheel 1.

The diameter of the pitch-circle of wheel 1 is twice as large as that of the pitch-circle of wheel 2. The wheel 2 carries a disc with a pin 3, which fits into the slot of a link-plate 4. The link-plate moves in parallel guides. The link-plate is joined to a rack, which ... the gear wheel 5 of the potentiometer. As the rack is shif- ... turns the wheel 5 which at the same time rotates the sliding ohtact of the potentiometer.

Let us now prove that for a turn of the wheel 1 through an angle ,and of the wheel 2 through an angle q relative to wheel I,the ontact of the potentiometer R_1 will move through an angle proportional to the product cos q sin .

In Fig. 14 let the line MN be the datum line for measuring the ngles; the line K for measuring the angles q. Line K moves bodily ith the wheel 1 as this turns through an angle 3. The point A is he initial position of the pin 3 (see Fig.13). The point A1 corresponds to the position of this pin after turning the gear wheel 2 through an angle q.

As the gear wheel 2 turns relative to wheel 1 the point A moves to position A_1 , also situated on the line KE.

In fact,since the ratio of the diameters of the circles is two to one,and arcs AC and A_1C must be the same, the central angles, corresponding to these arcs,must also be in the ratio two to one. This is satisfied by positioning the pin at the point A_1, since the angle A_1OC is twice as large as the angle CO A.

The distance OA_1 can be established from the triangle OOA_1 :

OA_1 = 2 r cos q , where r is the radius of the pitch-circle of wheel 2.

If wheel 1 is now turned together with wheel 2 through a angle the pin 3 will move along a circle with radius OA_1 to the point B. The distance BB_1 perpendicular to the line KE is then

BB_1 = OA, sin

Substitutin the expression for OA,we obtain: BB_1 = 2 r cos q sin

The rack connected to the link moves in a direction perpendicular to the line KE. It will therefore move a distance proportional to the product cos q sin .

5. ELECTROMAGNETIC DIAGRAM OF THE COMPUTING MECHANISM.

Introduction of the deck angle and of the angle of elevation the gun q which enter the equations,solved by the sight in the form of trigonometric functions sin q, cos and cos q sin is carried out by means of the potentiometers (transmitting potentiometers having a resistance of 160 Ohm R_{1h}; R_{1v}; R_{1s}; see Fig.11),placed [in the] computing mechanism.

[The po]tentiometers are connected into the electrical computing [...] angles of lead and sighting. The horizontal lag bridge includes the potentiometer $R_{1\,h}$, the vertical lag bridge the potentiometer R_{1v}, the sighting bridge the potentiometer $R_{1\,s}$.

Fig.15 represents the electrokinematic diagram of the calculating mechanism,consisting of the three mechanical devices for the trigonometric functions,each of which is joined to the respective potentiometer.

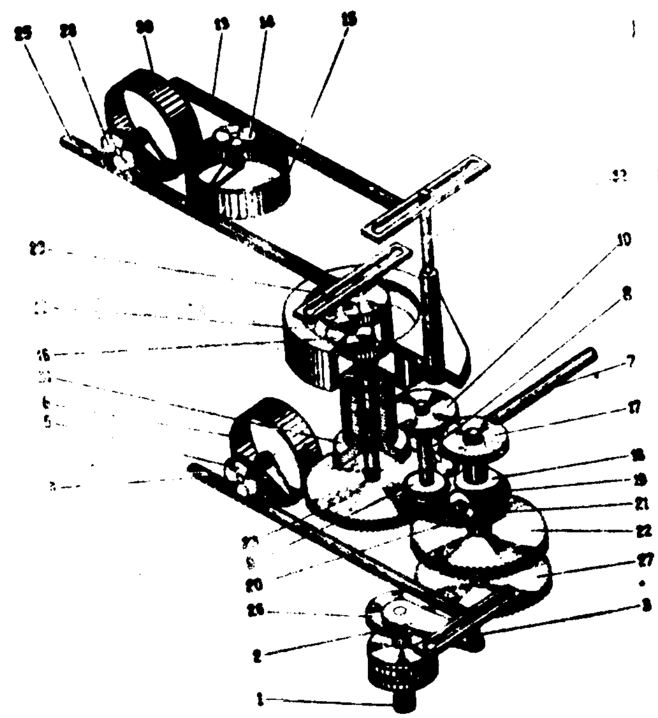


Fig.15. Electrokinematic diagram of the computing mechanism.

The angle q is introduced by means of the shaft 1 to the crank 2 with pin 3. The pin 3 fits into the link of the rack 4,meshing with the gear wheel 5,fixed to the shaft of the sliding contact of the potentiometer $R_{1\,h}$ 6.

When turning the shaft 1 through an angle q the crank is turned by the same angle and the rack is shifted by a value proportional to sin q.

As a consequence of this , the wheel 5 fixed to the shaft of the potentiometer changes the resistance connected into the horizontal lag bridge, proportional to sin q.

The rotation of the shaft 7 through an angle is transfered through the bevel gear B-9 to the gear 10-31. The wheel 31 is rigidly connected with the wheel 12, which carries a guide containing the pin 32.

The pin 32 fits into the link of the rack 13 and shifts it proportionaly to cos . The wheel 14 turns the sliding contact of the potentiometer 15, thus altering the resistance of the potentiometer, connected into the sighting bridge proportional to cos .

At the same time the rotation of the shaft 7 through an angle is transferred by means of the bevel gear differential to the wheel 16. Let us now deal with this train of gears .

The rotation from shaft 7 is transferred over the bevel gear 8-9 to the gear 10-17. The geared wheel 17 is rigidly connected with the differential bevel wheel 18. The rotation from the wheel 18 is transferred by means of idling wheels 19-20 to the bevel wheel 21 and through the spur wheels 22-23 the rotation is transferred to the wheel 16. As a consequence of this the wheels 12 and 16 will rotate together through the same angle and the link pin 29, fitting in the link-plate of the rack 25, will be displaced proportional to sin . Besides this, the wheel 16 is rotated relative to the wheel 12 through an angle q. Rotation of the shaft 1 is transferred by means of wheels 26-27 to the wheels 22 and 23 the last of which carries on its shaft the wheel 15 with the pin 29. Consequently, as a result of the introduction of the angles and q the rack 25 will be moved proportional to cos q sin .

The shaft of the potentiometer 30 carries a wheel 28. As the rack 25 is moved, this wheel rotates and changes the resistance connected into proportional to cos q sin .

6. ELECTROKINEMATIC DIAGRAM OF THE SPEED MECHANISM

The introduction of the plane's speed into the electrical computing bridge for the angle of lag is accomplished by means of the potentiometers R_{11} h; R_{12} h; R_{11} v; R_{12} v; (see Fig.11).

The horizontal lag bridge contains the potentiometers R_{11} h; R_{12} h, the vertical lag bridge the potentiometers R_{11} v, R_{12} v .

The electrokinematic diagram of the speed mechanism is shown on Fig.16. The shaft of the control 4 carries wheels 1 and 2, which [illegible] wheels 4 and 5, fixed to the spindles of the potentiometers

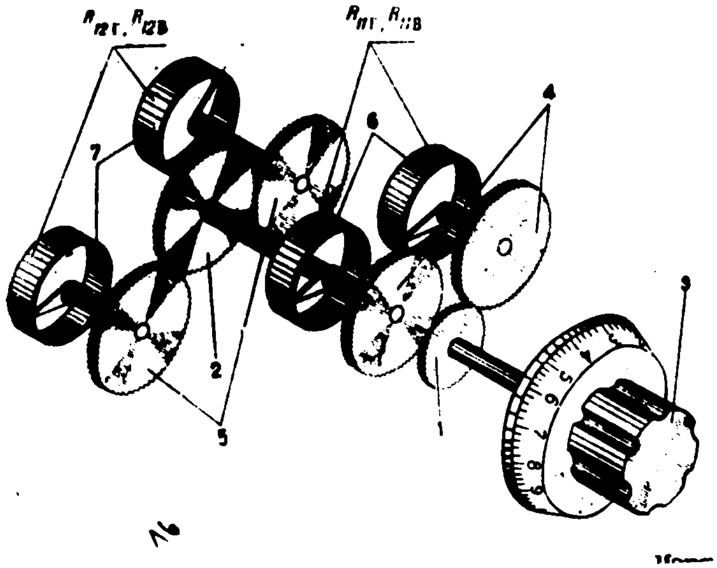


Fig.16.Electrocinematic diagram of the speed mechanism

According to the principal circuit diagram,potentiometers $R_{11\ h}$, and $R_{11\ v}$ are type PD-160 (transmitting potentiometers having a resistance of 160 Ohms); potentiometers $R_{12\ h}$, $R_{12\ v}$, PD-400) transmitting potentiometer having a resistance of 400 Ohms). The gear ratio from the speed control to the wheel of the potentio-meter PD-400 amounts to 1 : 1 and to the wheel of the potentiometers PD-160 to 1:2.

When introducing the plane's own velocity we adjust the graduated control 3 to the appropriate velocity. By this wheels 1,2 engaging wheels 4,5 respectively,are turned through the same angle,while the potentiometers 6,7 receive corresponding angular moves,as a result of which the currents in the small diagonals of the lag bridges are adjusted proportional to the plane's own velocity.

7.ELECTROKINEMATIC DIAGRAM OF THE ALTITUDE MECHANISM

The altitude of flight of the plane is introduces into the lead circuit and into the electrical computing bridges of the angles of lag by means of the shunts R_{04}, R_{05}, R_{06}, R_{07},R_{08} and a double po-tentiometer (R_{20v}, $R_{20\ h}$) see Fig.11. The sunts R_{04} to R_{08} are con-nected into the lead circuit. The potentiometer $R_{20\ v}$ is connected ... vertical lag bridge. The potentiometer $R_{20\ h}$ is connected into the horizontal lag bridge.

The electrokinematic diagram of the altitude mechanism is shown in Fig.17.

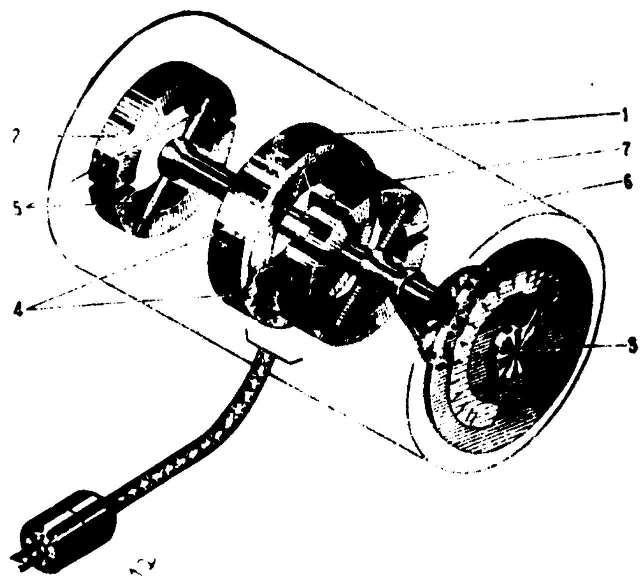


Fig.17. Electrokinematic diagram of the altitude mechanism.

The altitude mechanism is based on the resistors 1 and 2. Resis-
tor 1 has five movable contacts 4, by means of which at the time of
adjustment, the shunts R_{04}, R_{05}, R_{06}, R_{07}, R_{08} are s et. The movable
contacts 4 are connected with the stationary contacts 7. Along re-
sistances 2 as well as contacts 7 brushes 5 and 6 slide, which are
fixed to the shaft carrying control 3.

The each shunt R_{04} + R_{08} there corresponds its respective calcu-
lated altitude. The whole range of altitudes from 0 to 14.000 m is
divided into five steps.

Position No	Range of altitude m	Nominal altitude m
1	0 - 1500	1000
2	1500 - 3000	2000
3	3000 - 5000	4000
4	5000 - 8000	6500
5	8000 -14000	10000

As can be seen from the table, to every position there corresponds the respective range of altitudes. Thus, the altitude corrections are introduced into the angles of lead in the form of distinct steps.

Resistance 2 is formed by a potentiometer consisting of two independent halves, included into the bridge circuits: horizontal lag $R_{20\ h}$ and vertical $R_{20\ v}$. For the given purpose a potentiometer PDR 500 (double computing potentiometer having a resistance of 500 Ohms) is used, making it possible to introduce altitude corrections into the angles of lag.

For introducing the altitude of flight the altitude control 3 see Fig.17 is set to the required position marked on the dial. Thus brushes 5 and 6 are set correspondingly, at the same time altering the currents in the circuits of load and lag in proportion to the altitude of the plane.

8. GENERAL DIAGRAM OF THE SIGHT.

The general diagram of the sight is presented in Fig. 18.

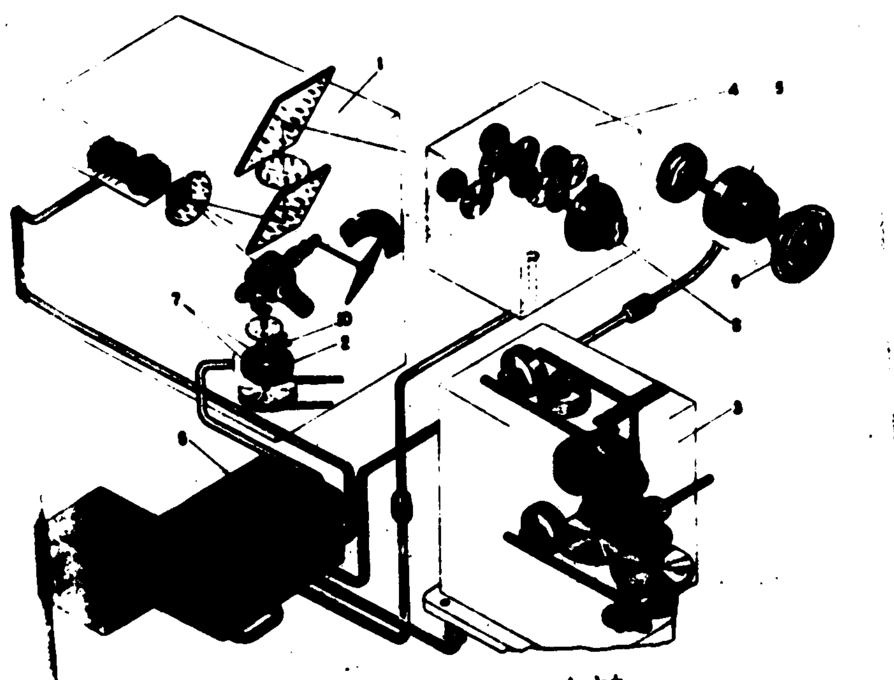


Fig.18. General diagram of the sight.

The functioning of the individual units of the sight is dealt with in detail in the previous paragraphs. In order to explain the principle of the sight function we will next examine the interaction individual units of the sight.

...roscope with the electromagnetic correction and the whole optical system is mounted in a unit called SIGHTING HEAD I.

The rheostats,connected in the lead,sighting and lag circuits, the resistances of which are altered as a function of the distance are constructionally combined in a single mechanism THE RANGE RHEOSTAT 2.

The mechanical devices for producing the trigonometric functions are combined in a separate unit called THE COMPUTING MECHANISM 3.

The plane's own velocity is introduced by means of the SPEED MECHANISM 4.

The altitude of flight is introduced into the sught by means of the ALTITUDE MECHANISM 5.

The electrical connection between the separat units of the sight is accomplished by means of the JUNCTION BOX 6.

Let us examine the formation of lead,lag and sighting angle corrections,made by the sight.

While following the target,the gunner turns the sight so as to prevent the central point from coming off the target and by turning the range control frames the target with the range-finder circle thus simultaneously introducing into the sight the angular velocity of the target and its range.

When turning the sight,the gyroscope axis follows the target with a velocity which is proportional to the angular velocity of the target. To introduce the range the brushes 7 are rotated, bringing into circuit resistances corresponding to the required range. The rheostats are connected in the lead, sighting and lag circuits.

The plane own velocity is introduced into the sight by adjusting the control 8 on the speed mechanism to the correct value.

When introducing the speed the resistances of the potentiometers connected in the diagonal of the horizontal and vertical lag bridges are changed.

The altitude of flight of the plane is introduced into the sight by turning the control 9 on the altitude mechanism to the corresponding value on the dial. This is accompanied of the potentiometer brushes,which introduced altitude correction into the horizontal and vertical lag bridges. The contacts of the shunt,connected in the lead circuit are switched at the same time.

... deck angle q and the angle of elevation of the guns are ... to the computing mechanism by the motion of the turret

In the process of following the target with the range-finder gr... the values q and , introduced into the computing mechanism are transfered to the computing devices for the trigonometric functions connected with the sliding contacts of the potentiometers.

The potentiometers then alter the current in the circuits, of lag and sighting bridges in proportion to sin q, cos and cos q sin .

As a consequence of the introduction of the above mentioned parameters into the sight, the currents necessary for forming the sighting data will pass through the coils of lead, lag and sighting.

IV. DESIGN OF THE UNITS OF THE SIGHT .

I. SIGHTING HEAD (Fig. 19 and 20.)

The sighting head is intended for producing the angular corrections for lag, lead and sighting - as a function of the parameters of aerial fire introduced - in the gunner's field of vision.

The production of the angular corrections is performed by the gyroscopic mechanism, which is located in the front cover of the sighting head.

The sighting head (Fig.19) consists essentially of three units - the body 1, front cover 2 and rear cover 3.

The body carries a box containing a drying agent 4. It also carries the light filter 5 and a mechanical view-finder 6.

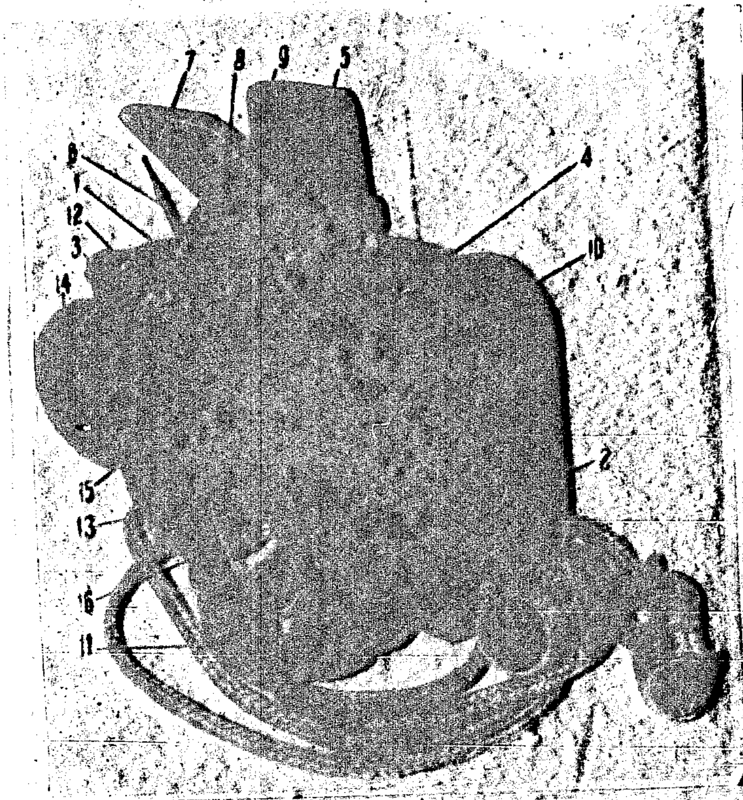
The semi-transparent mirror 7 is tightened to two supporting surfaces of the body with a clamping plate 8 and two screws 9. Both supporting surfaces lie in the same plane.

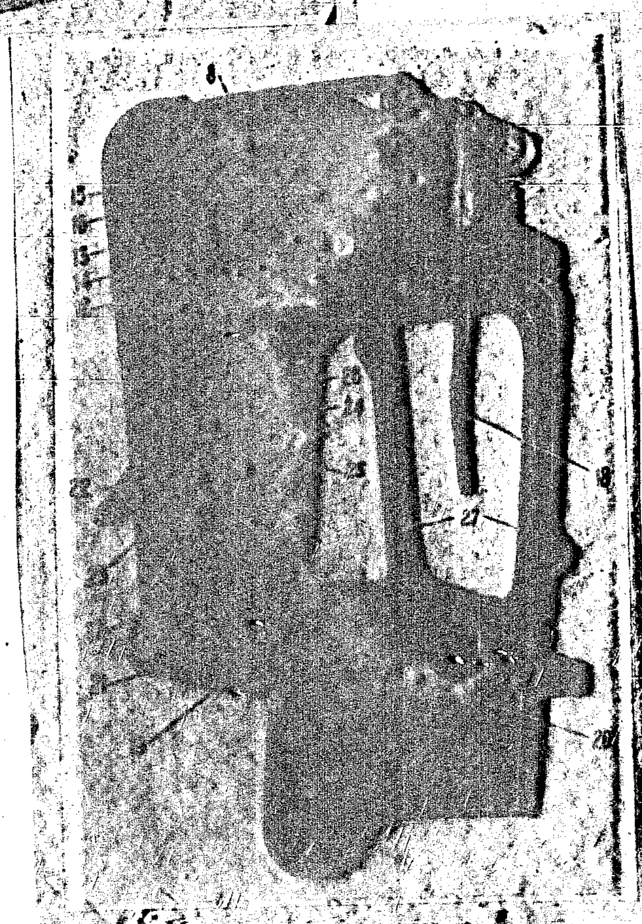
The body (Fig.20) is a detail uniting the whole sighting head. Besides the front and rear covers is also carried a side cover 10 (see Fig.19) and the range rheostat 11.

At the top the body carries a lens 8 (see Fig.2o) which is screwed in and tightened at the side with a lock screw. Inside the body two brackets 12 are attached for supplying the current. They carry two contact springs 13, pressed against the lens by means of screws 14. The contact springs touch the resistance coating 15 on the lens (heating element) by means of two soft contacts 16, rolled up from a silver foil.

From the bracket 17 the current is led by means of two tinned contacts to two corrocponding contacts on the rear cover.

Fig.19-20...page 37





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The tube 18 is part of a duct connecting the surrounding air
th the drier.
The range drum 19 with the range dial 21 and the bevel wheel
The range drum 19 with the range dial 21 and the bevel wheel
ot visible in the figure) are mounted on a common axis in a sleeve
xed to the body. The bevel wheel engages a corresponding wheel
the rear cover, whereas the drum is fitted with a pin 20, which
ts into a fork fixed to the spindle of the range rheostat.
A window in the body carries an index for reading the range dial.
is index and dial are needed during the assembly and adjustment
the sight.
At the left side of the bodx is the actuating mechanism of the
atch. The riffled control lever is screwed to the shaft of the lever
3 and can be rotated together with the shaft and the lever 23 bet=
een two stops fixed to the side of the body.
The shaft also carries a sleeve with the fork 24.
The sleeve can rotate independently of the motion of the control
ever 22 and lever 23. The lever shaft is turned by hand by means of
he control lever 22. The fork 24 receives its motion from the spring
5, fixed by its ends to two pins on the lever and on the fork. The
top on lever 23 takes no part in the function of the catch and is
nly needed during the assembly of this unit.
The spring 26, fastened by one end to the body and by the other
o the fork 24, serves to diminish the speed of the fork's rotation
nd to damp sudden shocks during the operation of the catch.
The right side cover is screwed to the body and is easilly de-
achable, thus making it possible to examine the interior of the
ighting head.
In order to tighten small gaps resulting from the imperfect fit
of the side, rear and fron covers, thin rubber bands 27 are glued
into grooves in the body at the joints, projecting over the surface
by 0,2 + 0,3 mm.

a) REAR COVER

The rear cover (Fig.21) contains details of the range-finder me-
chanism.
The outer side of the rear cover carries index 12 (see fig.19)
of the dial of bases, the safety cushion 2 (Fig.21) which serves at
the same time for turning the dial of bases 3, the lamp case 4 with
...ch 5, the lamp holder 6 with a bulb 7, the lamp rheostat 8, and

dditional resistor to the lamp rheostat 39 the plate 10 with stops
or the lamp rheostat.

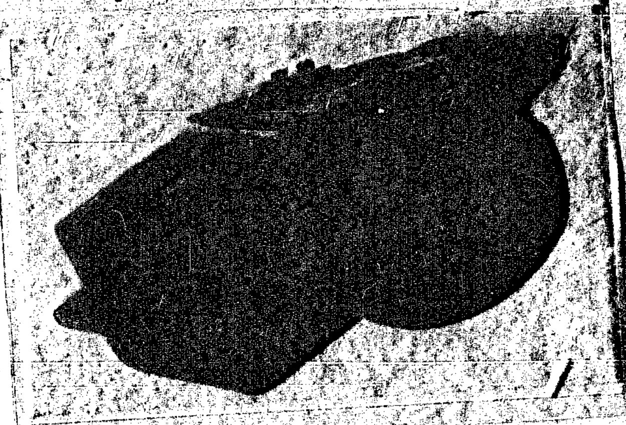
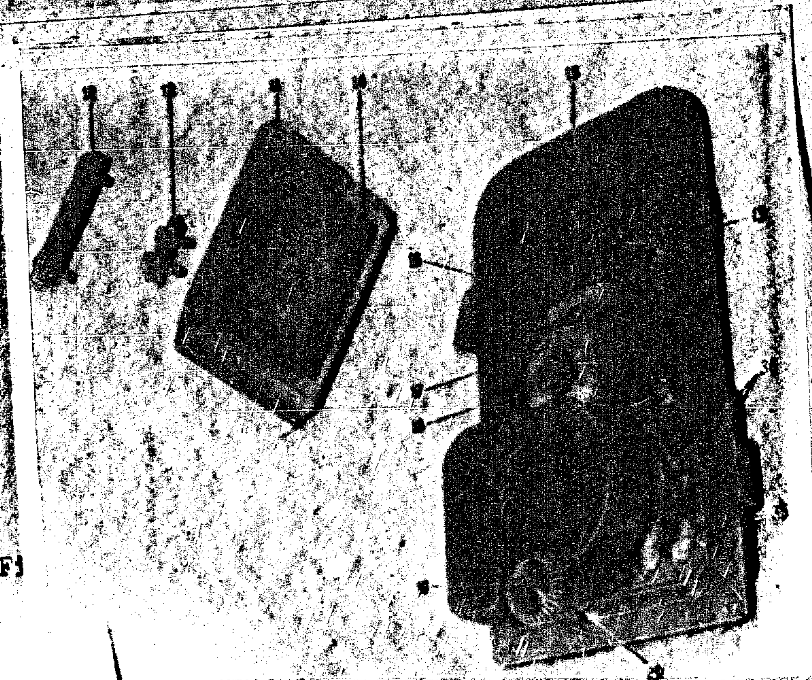


Fig. 21. Rear cover



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dditional resistor to the lamp rheostat 39 the plate 10 with stops or the lamp rheostat.

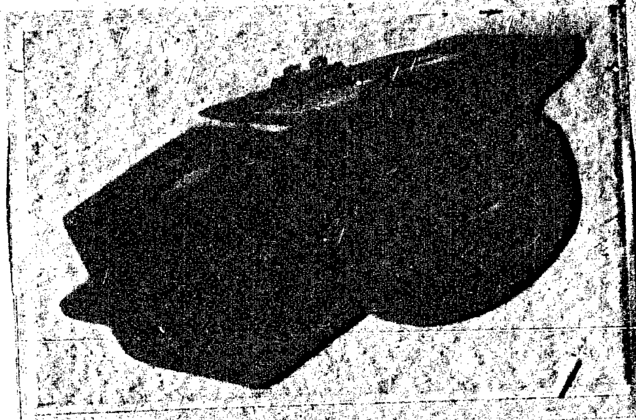

Fig. 21. Rear cover

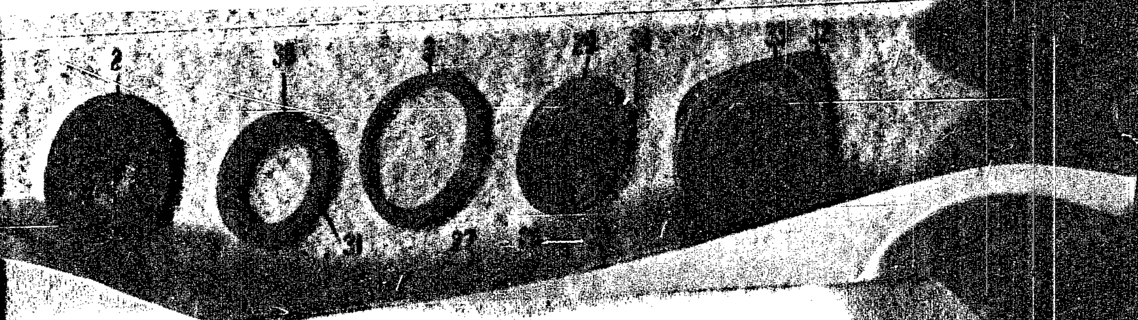

Fig. 22. Rear cover from the outside,dismantled

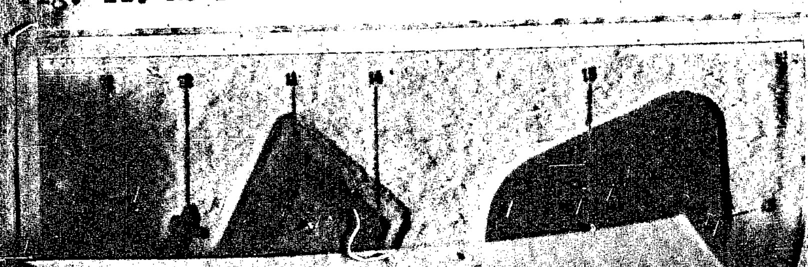

Fig. 23. Rear cover from the inside,partailly dismantled.

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On the inside of the back cover (Fig.23 is a stationary mirror 11, tightened with two clapping strips 12 to these supports at a definite angle to the cover, the contact strip 13, supplying current to a thin chromium firm 14. This film serves as a heating a element for the mirror. The wheel 15 with its schaft connected to the dial of bases, is coupled to the geared sector 16. The spur wheel 17 sits on a common shaft 18 with the geared sector 16.

The bevel wheel 19 meshes with the bevel wheel of the range drum. On a common shaft with the wheel 19 sits the spur wheel 20.

Wheel 20 (see Fig.23) engages the geared sector 22 (see Fig.22) of the mount 21. Into this mount the glass plate 23 having slits in the shape of logarithmic spirals is cemented.

Into the mount 25 with the geared sector 27 the plate 26 having radial slits is cemented. Wheel 17 (see Fig.23) engages the geared sector 27 (see Fig.22).

In this manner each of mounts is rotated independently of its dial. The dial of bases rotates through an angle 179^{0} 45 and witha gear ratio $\frac{1}{5,44}$ the mount 25 turns approximatelly through an angle 33^{0}. The range dial is marked on the range drum enclosing an angle 146^{0} 30 and with a gear ratio $\frac{1}{5,53}$ turns the mount 21 through an angle at about $26,5^{0}$.

Since the angle of a logarithmic spiral equals 39^{0}, one mount relative to the other must not turn more than 39^{0}. In this manner the circle formed by the ends of rhombs will vary in diameter from 3,15 mm to 22,96 mm.

To prevent one mount from turning relative to the other by more than 39^{0}, mount 21 (see Fig.22) carries stop screws 28, on which in the extreme positions the stops on mount 25 come to rest.

If on the other hand, one of the mounts turns relative to the other through more than 39^{0}, the radial slits will cross the neighbouring spiral slits and in the field of vision a second smaller or larger circle of rhombs will appear.

It was mentioned above that the diameter of the circle formed by the rhombs varies from 3,15 to 22,96 mm. This means that the parallactic angle varies from 17,5 to 122 thousandths.

In addition to the logarithmic spirals, radial slits and the ... points, the plates 23 and 26 (see Fig.22) also carry circular ... the same diameter, forming in the field of vision a constant diameter circle, used when firing in the position "Nepol" (stationary); its diameter is 23,8 mm, corresponding to an angle of 132 thousandths.

The shaft of the wheel 15 (see Fig.23) passes through the hole of the cover to its outside and rotates in this hole.

Plate 29 (see Fig.22) fastened to the shaft by a peg, carried by means of the screwed on ring 30 the dial of bases 3. By loosening the screws on the ring 30, the dial of bases can be turned relative to disc 29 and wheel 15 (see Fig.23). This is done when mounting and adjusting the range-finder rings. A safety cushion 2 is tightened with screws 31 to ring 30 (see Fig. 22).

The outer side of the back cover carries a stop, limiting the motion of the dial of bases and wheel 15 (see Fig.23).

The lamp holder cover 4 (see Fig.22) carries inscriptions showing the direction of rotating the illumination control and of the switching lever of the gyroscope arresting mechanism. The catch 5 on the lamp holder cover is spring loaded, the spring being held by the retaining pin.

The lamp rheostat of two plates, wound with resistance wire and placed against, each other; between them rotates a "caobolite" fork with contact springs. The fork site on the spindle of the rheostat. By turning it introduces a greater or smaller portion of the two resistors, thus altering the value of the introduced resistance.

The rheostat spindle pases through a hole in the plate 10 (see Fig.22), screwed to the back cover with two screws. A stop on the plate serves to limit the motion of the illumination control

The illumination control, fastened to the rheostat spindle with screws, has on its bottom a circular groove into which the stop on the plate fits. This serves to limit the motion of the rheostat spindle. In one extreme position the resistance introduced equ-ls 0,5 - 1,5 Ohms while in the other 170-200 Ohms. The fastening of the illumination control lever to the shaft is performed with both the carrying fork and the lever resting against the stops in identical positions.

The left bottom part of the rear cover carries two brass bushes 35 (see Fig.23), insulated by textolite tubes. These bushes pass through the rear cover and serve as contacts by means of which the rear cover is connected to the contacts 17 (see Fig.20) placed in the body.

From one of these bushes the lead goes to the illumination [illegible] from there to one of the lugs on the lamp holder. The other bush is onnected to the other lug; also from these bushes two leads 35 pass long the inside of the cover (see Fig.23) to the contacts 13,which ransfer the current to the heating element 14 on the mirror.

In addition to the lamp holder the lamp holder cover contains a crewed mount 37 (see Fig.22) with a protective ground glass.

Between this mount and that of the plate with radial slits a pring washer 38 is placed to reduce the axial clearance of the plaes mounts. The rear cover is tightened to the body with six screws itted with lock washers. When sitting the back cover the bevel wheels ust mesh and the contacts 35 (see Fig.23) must touch the contacts on the contactstrip (see Fig.20).

b) FRONT COVER

The front cover (Fig.24) consists of plate 1, to which are attahed : gyroscopic assembly 2, motor 3,connector 4 with ten-conductor able 5, tube 6, to which sith a nut 7 coil 8 is attached,fitted on strips 10 for the witing of the front cover,electromagnetic relay 11 for controlling the heating of the gyroscopis assembly, spark extinguishing resistor 12 for the heater,four supports 13 to which is attached the limiting frame 14 of the gyroscope and the arresteng mechanism 15.

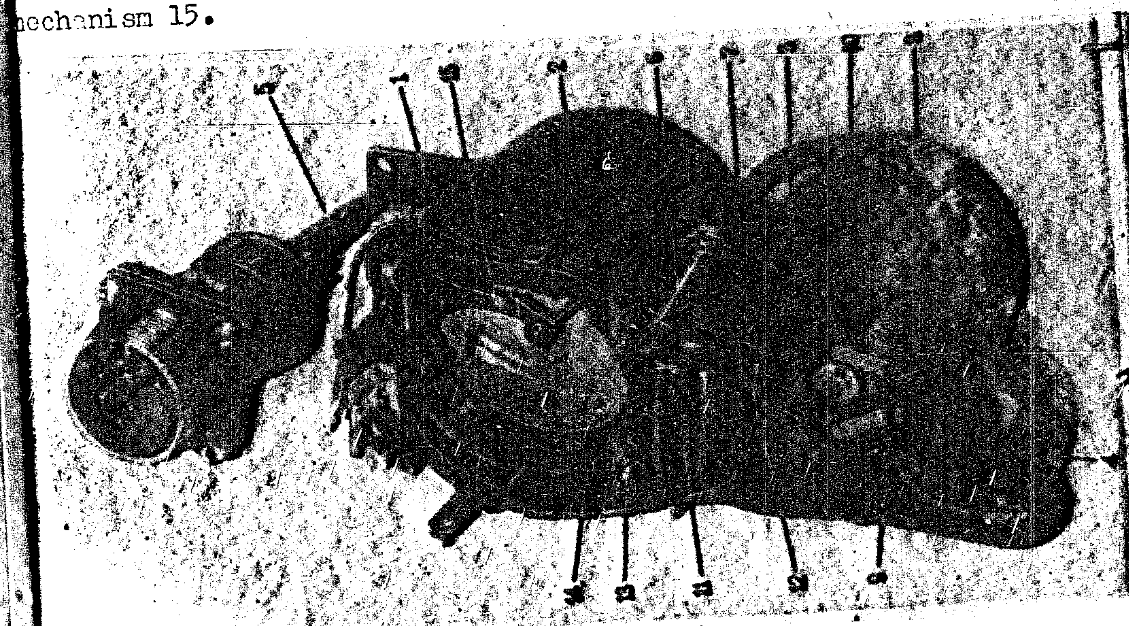


Fig. 24 . Front cover.

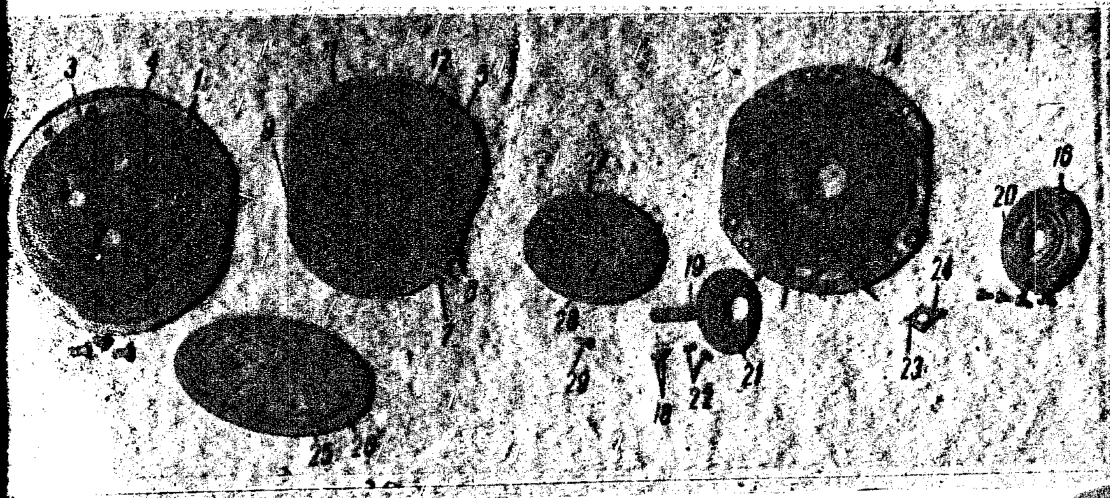


Fig.25. Gyroscopic assembly, dismantled

The electromagnetic assembly consists of the body 1 (Fig 25) having the form of a tumbler. On the bottom there are four threaded holes for the threaded adjusting discs 2 (Fig.26). An aluminium plate with four cores 4 is screwed to the bottom of the body by means of five screws. The body,adjusting screws and cores are made of an alloy of high magnetic permeability.

The four adjusting discs are each placed opposite the four cores 4, leaving a small adjustable gap of 0,5 + 0,6 mm.

By changing the gap it is possible to control the magnetic flux and consequently the magnitude of the braking force, acting on the gyroscope under each of the four poles. A brass spherical cup of the gyroscope under each of the four poles. A brass sphericaal cup of the gyroscope under each of the four poles.

The bifilar winding is necessary in order to exclude the influence of the heating current on the magnetic field of the coils.

Inside the body a thermoregulator 7 is fitted in special giudes (Fig. 25).

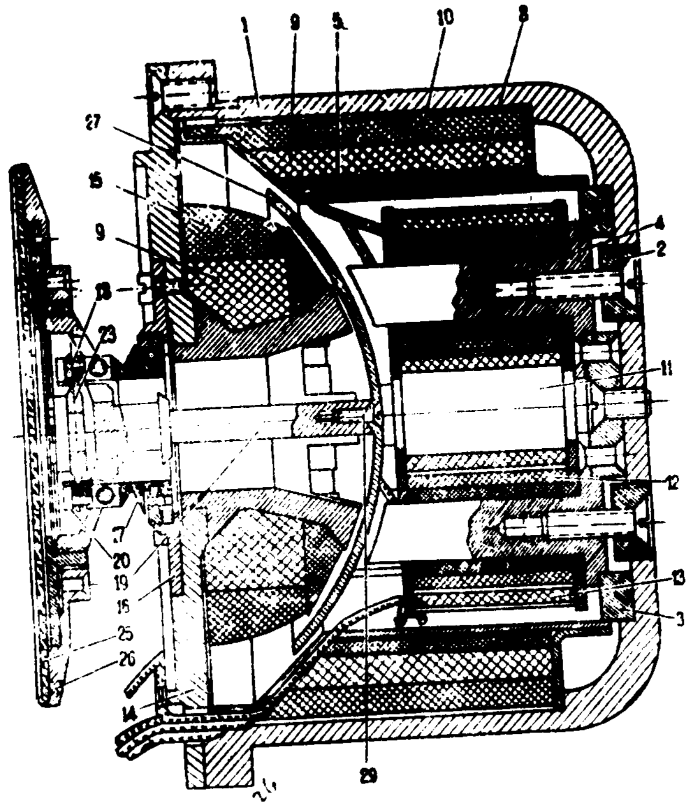


Fig.26. G y r o s c o p i c a s s e m b l y.

The thermoregulator consists of a bimetal strip 1 (see Fig.27) with a tungsten contact, and an insulated metal yoke 2 with an adjustable contact 3 on a screw.

The bimetal strip bends due to the raised tamperature of the surroundings of the thermoregulator thus opening the contact 3. If on the contrary, the temperature is lowered, the bimetal strip bends in the opposite direction thus closing the contact 3.

The bending of the bimetal strip as a result of the variations of the temperature is due to its being made of two layers each of different metal. Each metal has its own coefficient of linear expansion,which greatly differs from that of the other.

The adjustable contact 3 is set for the contact to open at a temperature of 47 ± 5°C and to keep bending away for increasing temperatures.

If the temperature falls below 47 ± 5°C, the contacts close [illegible] the currents pass into the coil of a relay that connects

Fig. 27. Thermoregulator.

he circuit of the heating elements.

The horizontal lag coils 11 (see Fig.25,26) are mounted on the wo horizontally placed cores. Each coil resistance equals 72 Ohms he vertical lag coils 12 are mounted on the vertically placed cores. he resistance of each coil equals 64 Ohms. The sighting coils 13 re wound on top of the coils 12. The resistance of each sighting oil is 10 Ohms.

The body 1 is closed with a cover 14 into which is mounted the gyroscope, a part of the range coil 9, with 470 turns of wire having a resistance of 6 Ohms and on top of this the third bifilar heating element 15 having a resistance of 15 Ohms.

The frame 16 with a ball-bearing is attached to the cover 14. Into the inner ring of the bearing a belt-pulley 17 is pressed and rolled in. It has two conical pivot bearings 18, fastened by means of a bush with an adjusting screw. On the end carrying the mirror the aluminium shaft 19 of the gyroscope is widened into a flange having an outer thread and a hollow recess. The flange itself has two openeings,through which pass projections 20 of the belt-pullay with the conical pivot bearings.

Between the plate 21 and the flange there is screwed another pair of pivot bearings 22.

The cross-piece 23 is supported in the pivot bearings located on the flange of the shaft and in the pivot bearings on the projections from the pullay which pass through the openings in the bottom of the flange.

To the cross-piece a spring filament 24 is attached, the loose end of which touches during the deviation of the gyroscope axis an adjustable stop (screw), screwed into the flange. The gyroscope mirror 25 is fixed in a brass mount 26 its diameter being smaller ... of the mount. As a result a circular strip is formed on e edge of the mount. At the rear of the mount petal-shaped eces with holes are distributed on its circumference. Ba bending e petals the gyroscope can be dynamically balanced. The brass unt riveted to an aluminium part,which has a threaded hole. By ans of this threaded tight on to the threaded flange of the f roscope shaft.

The aluminium cup 27 is attached to the other end of the gyros- pe shaft. This end is somewhat thicker than the axis itself and ntains a countersunk threaded hole.

The cup 27 also has in its centre a conical depression 28,with a ole. Through this hole passes a countersunk screw 29.,which is rewed into the shaft and holds the cup 27 to the shaft.

Complete symmetry of all parts of the gyroscope relative the ometrical axis of the gyroscope is absolutely essential.

A number of holes,distributed centrally on the middle part of the up,serves to correct the action of the magnetic fluxes in accordance ith the calculated formulas.

A limiting frame 14 of the gyroscope is mounted on four threaded upports 13 (see Fig.24). It protects the gyroscope from damage hould it leviate from the axis of the electromagnetic assembly by ore than 12°.

The limiting frame 14 carries a contact strip 31 (see Fig.28) o which a lead from the motor is brought out.

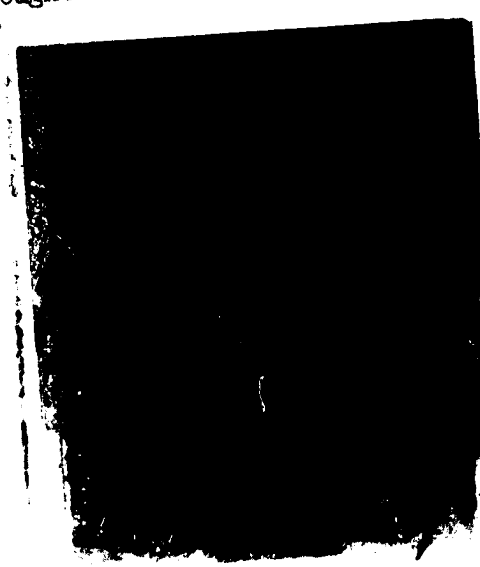


Fig. 28.
Arresting mechanism.

A lever 33 free to turn around pivots 32 is set into motion by he catch mechanism in the body engaging the pin 34,placed on the ever. The angle of swing of the lever is limited by resting in one xtreme position against the projections 35 of the limiting frame, n the other by the fingers 39, 40 against the mirror mount.

The lever 33 carries a contact 36 which, when raising the lever o the stop joins the contacts on the strip 31 and switches on the otor. At the extreme bottom position of the lever the motor cir-uit is disconnected.

The lever 33 is fitted with three adjustable fingers threaded on one nd,which are secured after adjustment by the nuts 38. Two of the hree fingers carry rigid "textolite" pads 39. The movable texto-ite pad 40 on the third finger is spring loaded the spring being nside the finger. All three fingers are adjusted in such a way hat at the extreme bottom position of the lever the pads rest gainst the circular strip on the mount of the gyroscope mirror, the ovable pad 40 pressing the mount against the other two rigid pads.

Thus the mirror and the gyroscope are arrested in a definite osition, the contacts on the contact strip 31 are disconnected,the otor switched off, so that the gyroscope does not rotate. This posi-ion is adjusted by the pivots 37 so as to make the gyroscope axis oincide with the axis of the electromagnetic assembly.

The described mechanism is called the arresting mechanism

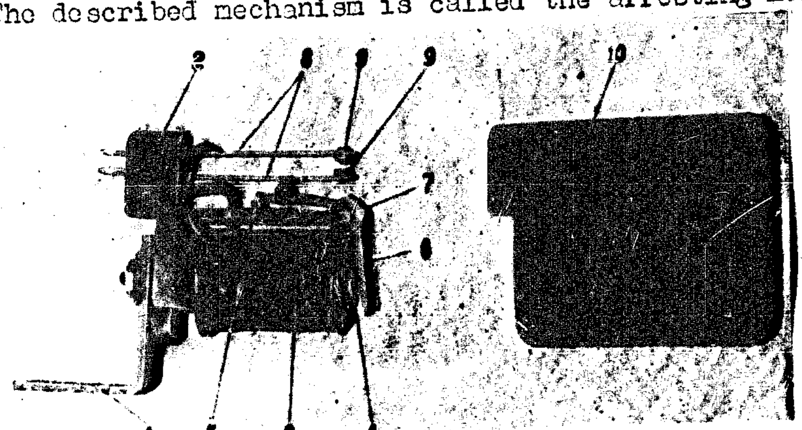


Fig. 29. - R e l a y .

The relay (see Fig. 29) consists of a bracket 1 (Fig.29)"carbolite" [illegible] 2,coil 3, core 4, yoke with a stop 5, armature 6 claps spring 7 [illegible] contact springs with silver contact springs 8, another two [illegible] 9 in accordance with the assembly and main diagram. The l resistance is 610 Ohms. The relay is protected by a cover 10.

c) D R I E R

The drier (Fig.30) carrying the light filter is an independent unit is attached to the body with two screws 1. The main part of the er is the body 2 with a threaded hole to take the threaded mount with an observing window. The body has the shape of a box,the er part of which is divided by a partition into two parts,connected h each other.

Fig. 30. D r i e r with light filter.

for the screws 1

the inside of th

ir, T

,coloured bright blue.

moisture from the air passing

t changes its colour to a

l resistance is 610 Ohms. The relay

c) D R I E R

The drier (Fig.30) carrying the li
is attached to the body with t
er is the body 2 with a thre
with an observing window,
er part of which is div
h each other.

Fig. 30. D r i e r with light filter.

The holes for the screws 1 pass through reinforced parts of the rtition and the inside of the body is not, therefore, in contact th the outer air, The body is filled with silicagel consisting of rains of the dried gel of silicic acid, coloured bright blue. Silicagel has the ability to absorb moisture from the air passing this layer. At the same time it changes its colour to a

The body of the drier is tightly closed with a metal cover 5, fastened to the body with screws 6. Between the cover and the edges of the body a rubber gasket 7 is interposed. The cover has two holes into which two flanged sockets with fine protective grids are inserted.

The grids prevent the grains and powder from falling out of the body. The protective grids consist of metal and silk nets, with cotton-wool interposed. On the top of the body there are two ears 9, through which the shaft 10 passes. The bar 11 pegged to the shaft carries the filter 14 which is fastened with screws 12 and washers 13.

Between the filter and the bar 11 rubber washers 15 are interposed, between the filter and the washers 13 washers 16, preventing the filter from being damaged by the screws. On the left end of the shaft 10 is a pegged lever 17 for raising and lowering the filter.

The motion of the lever 17 is limited by a screw 18 and stops. In order to secure the filter in a raised or lowered position, a ball loaded by a spring 20 is placed in a hole in the body. The lever contains two conical hollows into which the ball snaps.

d) MECHANICAL SIGHT

A mechanical sight is screwed to the right side of the sighting head body (Fig.31).

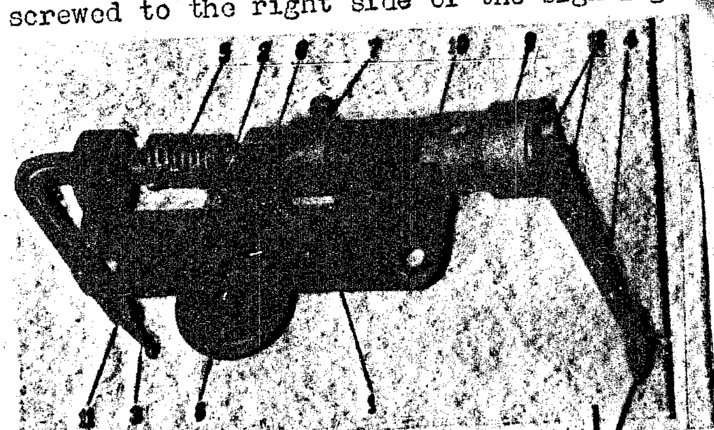


Fig. 31.
Mechanical sight.

In the bracket 1 there rotates the spindle 2 with a foresight 4 and a backsight 3. The spindle is fitted with a spring 5, the bracket with a catch 6. In the folded position, the backsight is hidden in a groove in the body and the foresight between the filter and the semi transparent mirror. The spindle with the sleeve 7 and the stop 8 can be turned till the catch 6 depressed by the spring 5 engages the stop. In this case the mechanical view-finder is removed from field of vision.

If we depress the catch 6, the spring 5 brings the sight with he backsight and foresight consisting of a ring and cross into the ield of vision. The spindle with the sleeve 9 is resting now against he new stops 10. The sleeves 7 and 9 are fastened on the spindle with pegs.

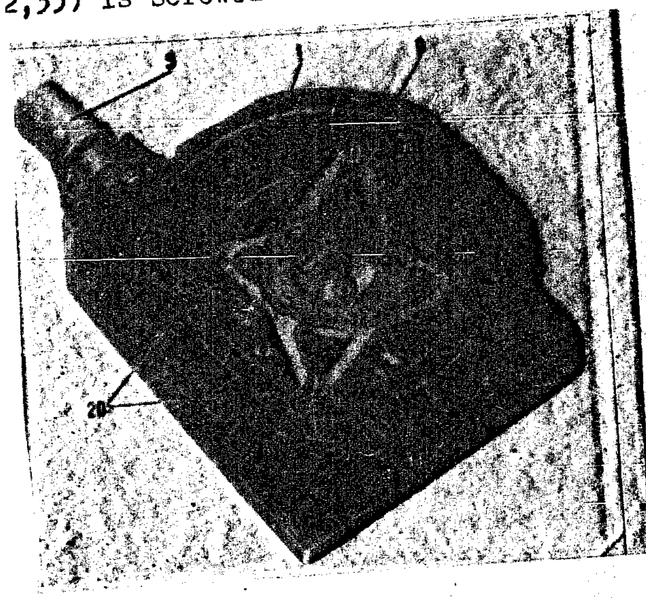
The line of sight of the mechanical sight is adjusted by screwing he backsight 3 in or out, whereupon it is secured with the nut 11. It is also possible to adjust the foresight 4; for this purpose he screws 12 are loosened.

2. - RANGE RHEOSTAT

The range rheostat is intended for altering the current in the lectical computing circuits in accordance with the range.

Brushes, turned through an angle corresponding to the range of ire, set the rheostat to such resistances which, connected in the lectrical computing circuits, pass the required currents.

The range rheostat (Fig.32,33) is screwed to the bottom of the ighting head.



ig. 32. Range rheostat.

The range rheostat consists of a body 1, ring 2 with resistances ixed thereupon, cover 3 with the control knob 4 and cable 5. Into he base of the body 1 a bush 25, through which the spindle 11 of he rheostat passes, is screwed in. One end of the spindle carries fork 10 (see Fig.13) which is pegged to the spindle during the eneral assembly of the sight. Into the slot of the fork fits a pin 20 of the range drum (see Fig. 20).

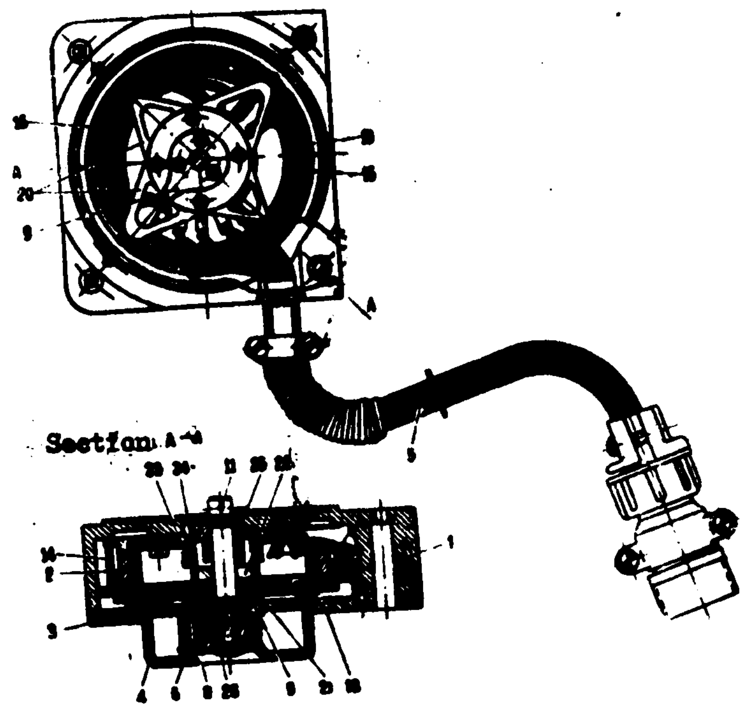


Fig. 33. Range rheostat

The ring 22 (Fig.32,33),fixed to the spindle 11, has a projection by which its movement is limited on the stops,placed on the bush 25. This permits the rheostat to be adjusted through an angle,equalling 152°. Four sliding contacts 20 are attached to the insulating plate 21, rigidly fixed to the ring 22. The current is supplied to the brushes by means of a brass spiral 23,mounted on an ebonite bush 24,

The ring 2 carries a panel with two groups of eyelets:to one group of the leads of the cable are soldered,the other group serves for the internal wiring.

The rheostat contains four independent windings (Fig.34) on which by means of sliding contacts the resistance connected into the computing circuit is set

The rheostats are wound on two circular formers 15,19 (see Fig.33).

Winding 1 (Fig.34) is connected into the angle of lead circuit.

Winding 2 is connected into the sighting bridge circuit.

Winding 3 is connected into the horizontal lag bridge circuit.

Winding 4 is connected into the vertical lag bridge circuit.

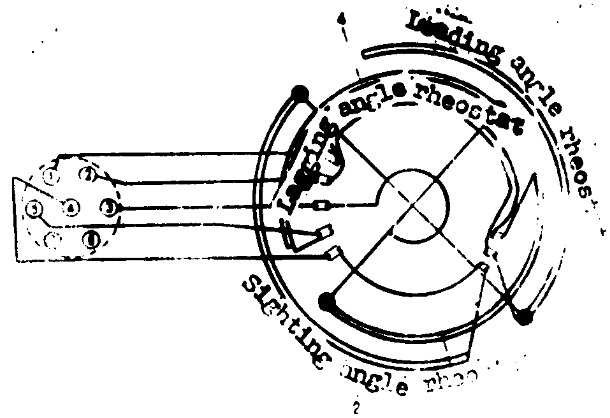


Fig. 34. Wiring diagram of the range rheostat.

This distribution of the windings on the formers is caused by e necessity of obtaining certain dependences between resistance t and the range introdeced in the form of the angle of turn of s sliding contact.

Sindc we are ultimately interested in the time of flight, of the rojectile to the target rather than in the range it is evident at the dependance of the resistances on the distance can be calulated only for a gun of certain ballistics. The designation of he adapted ballistics is engraved on the cover of the rheostat.

The cover 3 (see Fig. 32,33) of the rheostat, carries the control f the range rheostat. The rotation of the drum 4 is transferred by pin, fitting into a groove on the drum. The pin is on a belt-pulley, laced on the device.

The drum 4 turns on the spindle 26, located on the cover 3. The drum conti ins a spring 8, the ends of which are anchored on the lug 6.

Between the lug and the ends of the spring a space is formed into which fits a wire, attached to the spindle of the rheostat.

As the drum 4 rotates, the spiral spring 8 carries along the wire 9 with the axis 11 of sliding contact. The brushes slide along the rheostat winding, thus changing the resistances in the corresponding circuits and producing the correction for the range.

The spring connection between the drum and the carrying fork is intended to prevent the nimonatic circuit of the range-finder from being damaged should the mounts of the plates in the range-finder ...anism move as far as the stop. In this case the wire 9 remains otionless during the continued rotation of the drum while spiral pring gives way.

It was mentioned above that with targets of small size it is impossible to obtain large distanced , i.e. the mounts of grid plates est against their respective stops. Consequently the range drum and he rheostat spindle with the wire 9 comes to a stop.

Meanwhile however the gunner tries to inscribe the target i.e. to iminish the visible ring. In this case the spring 8 of the range heostat control has the purpose of preventing it from being damaed. It also functions in the same way with targets of large size nd small distances. In order to prevent the spring 8 from breaking he drive also equipped with stops,which permit the drum to revolve nly through 180° , i.e.through 28° more than the value of the angle f turn of the spindle of the rheostat. If the range is altered rom 800 to 180 m, the range drum and the spindle of the range rheost revolve through 146.5°.

When establishing a range of 180 m, the sliding contacts on the winding,connected in the circuits of angles of lead are set to a re sistances of 1.9 Ohms,and on the winding,connected in the sighting circuit to a resistance equal to 95.37 Ohms.

When establishing a range equalling 800 m, the sliding contacts are set to a resistance on the winding of lead equal to 95.81 Ohms ; the resistance of the sighting winding is equal to zero.

The resistance of the winding connected in the circuits of the bridges of lag must equal 110.68 Ohms, when the range is set to 180 m,whereas for a range of 800 m their resisatance equals zero.

The sliding contacts 20 (see Fig.32,33) of the rheostat are made of bronze 0,2 mm thick and to their ends are soldered silver contacts, which slide slong the windings of the rheostat.

The pressure of the contacts on the windings amounting to 20-40 g secures reliable contact under conditions of vibration of the plane.

The range rheostat is fitted to the sighting head in the factory.

3. COMPUTING MECHANISM

The computing mechanism serves to produce and introduce into the electrical computing circuits of the horizontal and vertical lag bridges, as well as into the electrical computing circuit of sighting distances,proportional to the trigonometric functions of the gles of adjustment of the gun in both the horizontal and vertical rection (sin q cos ; cos q sin).

These resistances are necessary in order to obtain, in the diagols of the above mentioned bridges as well as in the supplementary ils connected in the diagonal, currents ensuring in the sight the viation of the line of sight through angles of lag and sighting accordance with the dependances reffered to in Chapter III.

In addition, the computing mechanism contains fixed and variable sistors of the electrical computing bridges, by means of which the ght is adjusted at the factory.

The computing mechanism consists of three mechanical devices for oducing the trigonometric functions: the sine device , the cosine vice and that for the product of sine and cosine. Each of these vices is coupled to the respective potentiometer the sliding conct setting and consequently also the resistance of which is proportional to this setting, will be proportional to the correspondin rigonometric function of the value q and , introduced into the ven device.

A view of the computing mechanism, with the protective cover remov s shown in Fig. 35.

All the assemblies of the computing mechanism are fitted on to two lates: the lower plate 1 and the upper 2, being rogodly joined to ach other by posts. In addition the lower plate 1 serves to fix he mechanism to the turret.

Fig. 36 shows the lower plate (next to the dismantled driving haft of the horizontal angles of the gun).

<u>The lower plate carries the following units and details</u>

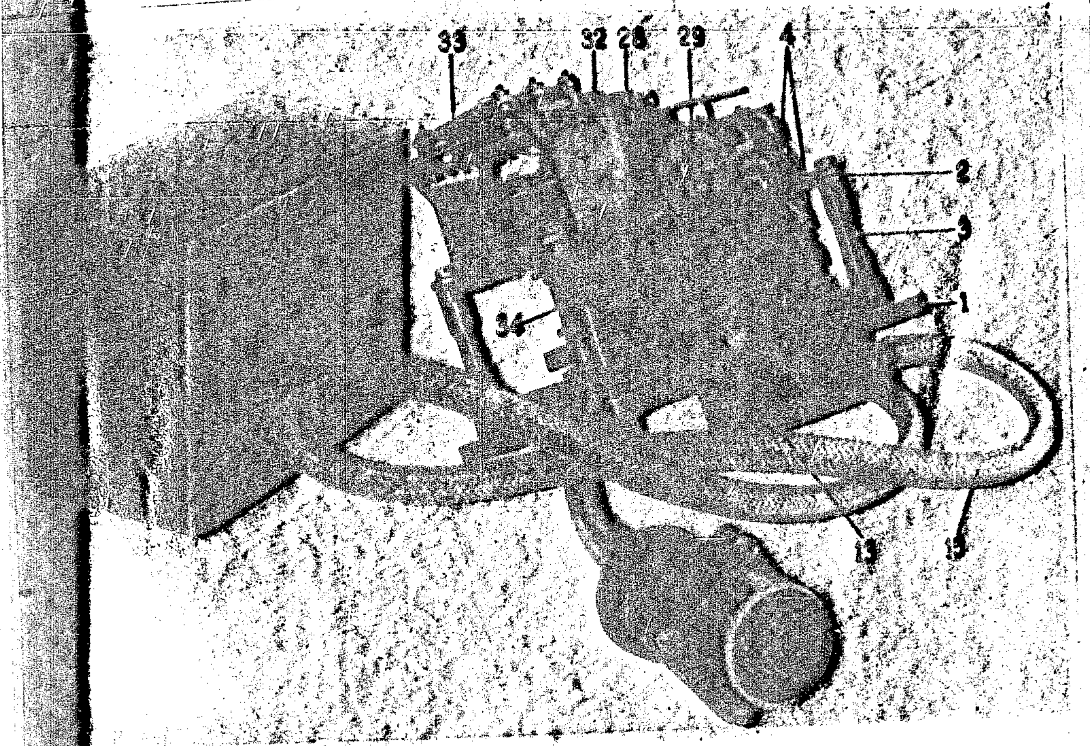
Shaft 1, which is connected during the fitting of the mechanism o the turret. This shaft introduces into the computing mechanism the ngle q - the deck angle of the gun (angle of revolving the turret nd consequently also that of the sight in a horizontal plane).

On the other end the shaft 1 is connected by a coupling 2 with bush 3, rigidly mounted on a shaft with a gear wheel 4. This shaft lso carried a crank with a pin 6 attached on the gear wheel end.

The bracket 7 serves for mounting the potentiometer 8. The holes n the bracket serve as a guide for the rack and link 9.

Shaft 10 with a gear wheel 11. When fitting the mechanism to the

Fig.No.35-36 ....page 55


33
32
28
29
4
2
3
1
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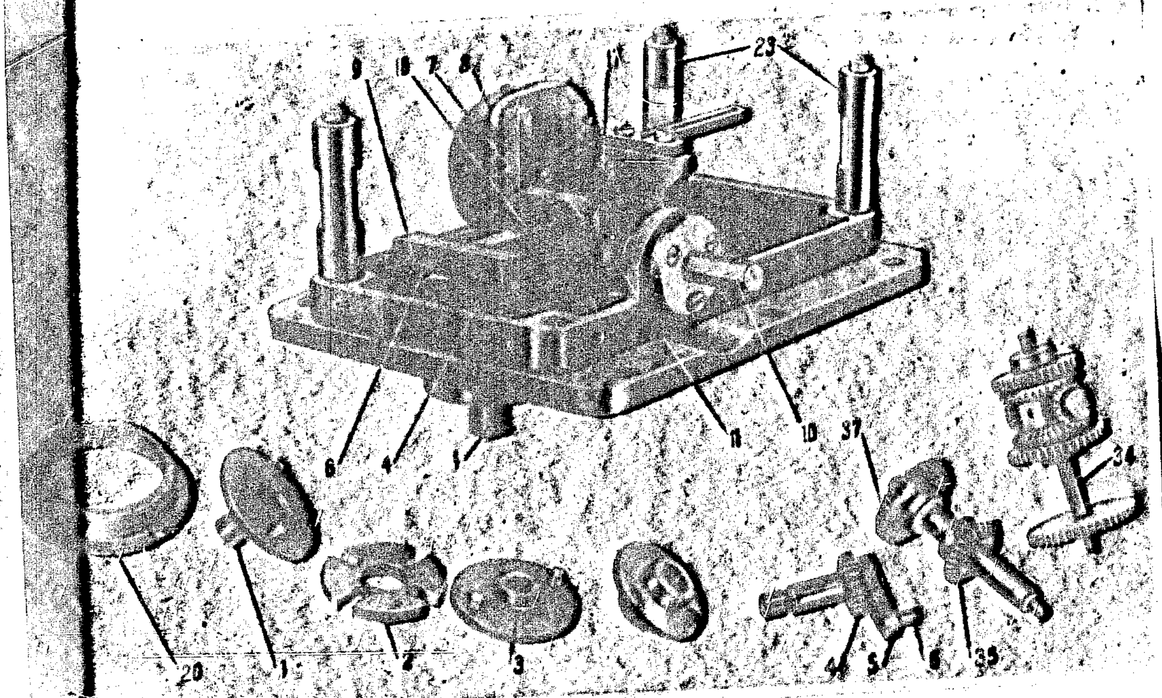
13
15


9
23
6
4
1
11
10
37
34
20
1
2
3
4
5
6
35

turret a toothed sector is attached to,the shaft 10. By means of this sector the angle , i.e. angle of elevation of the gun,is introduced from the turret into the computing mechanism.

The posts 23 serve to fasten the upper plate.

The limiting plate 13 (see Fig.35) is equipped with stops,limiting the angle of turn of the shaft 10 (see Fig. 36).

The terminal strip with a cable 15 (see Fig.35) connects the mechanism with the electrical circuits of the sight.

When turning shaft 1 (see Fig.36) through an angle q, crank 5 turns through the same angle. The crank pin 6, fitting into the slot of the link 9 at the end of the rack 16 shifts this through distance r sin q (where r is the radius of the crank). The rack meshes with a gear wheel 17 on the spindle of the potentiometer 8. Since the wheel is mounted to the spindle of the potentiometer, it is evident that the sliding contact will turn through the same angle as the gear wheel 17.

The rack 16 meshes with a gear wheel 17 in such a way that for zero position of the crank the sliding contact of the potentiometer divides the resistance into two equal parts. As the rack 16 moves through the distance r sin q, the sliding contact will revolve through an angle proportional to r sin q, causing a change of the current in the horizontal lag bridge in proportion to sin q.

Thus the sine device moves the sliding contact of the potentiometer in accordance with the law sin q. In accordance with this law, the current will also vary in the circuit of the horizontal lag bridge.

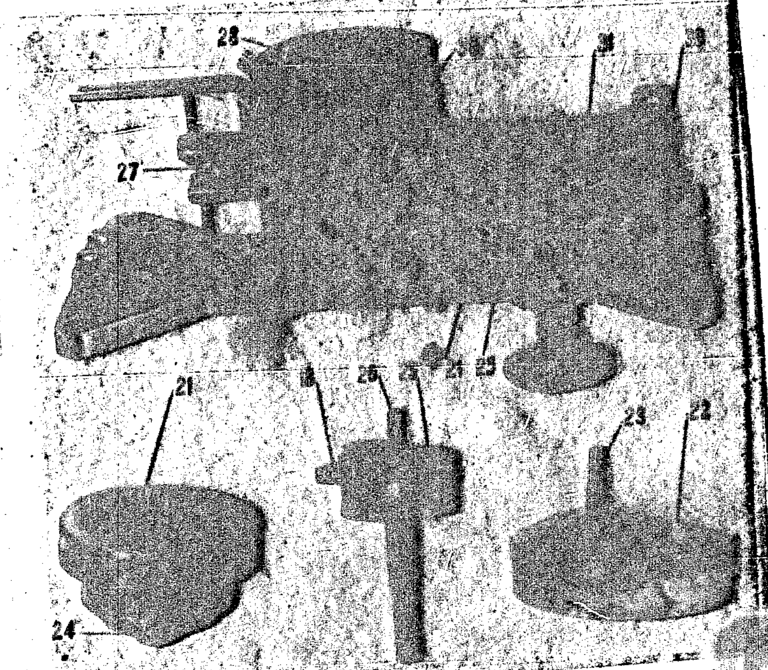
The potentiometer 8 in the circuit of the horizontal lag bridge is marked $R_{1\ h}$ and is called the horizontal lag potentiometer.

For adjusting the zero position (q = o) of the sine device, adjusting marks are located on the flange of the shaft and the hood 20.

The upper plate (Fig.37) carries the following units and details.

Rigidly attached to the outer circumference of the internal gear wheel 21 is the fixed guide 22 with the pin 23.

Fixed to the bottom of the same wheel 21 is a gear wheel 24. The centre of the gear wheel 21 has an opening which serves as a bearing for the guide 25. The guide carries a crank with a pin 26. The crank ...idly attached to a gear wheel 18,which engages the gear wheel 21.



wheel 18, mounted in the guide, serves for
wheel 21 the rotation from the shafts for
q and ε. The compensating resistors JUS-50,JU
4 (see Fig.35) are connected into the electrica
dges. By means of these resistors the sight is adj
factory.
e bracket 27 (see Fig. 37) serves for mounting the potenti
9 (see Fig. 35,37). The holes in the bracket serve as a guide
racks with links 30, 31.
bracket 32 (see Fig.35) carries fixed resistors 33 of 100
each, connected in the electrical computing bridges.
addition to the mentioned parts mounted on the lower and upper
details are interposed between them, uniting the upper and
plate kinematically.
differential 34 (see Fig.35,36) transfers the summary angle
the drives of q and ε to the gear wheel 18 (see Fig. 37). The
wheel 35 (Fig.36,38) and the spur wheel 37 transfer the ro-
tion from the shaft 10 of the drive of ε to the differential and
r wheel 24.
wheel 11 rigidly fixed to the shaft 10 will follow each rptation
of this shaft through an angle ε.
The angle ε is transfered over the bevel gear 11 - 35 to the spur

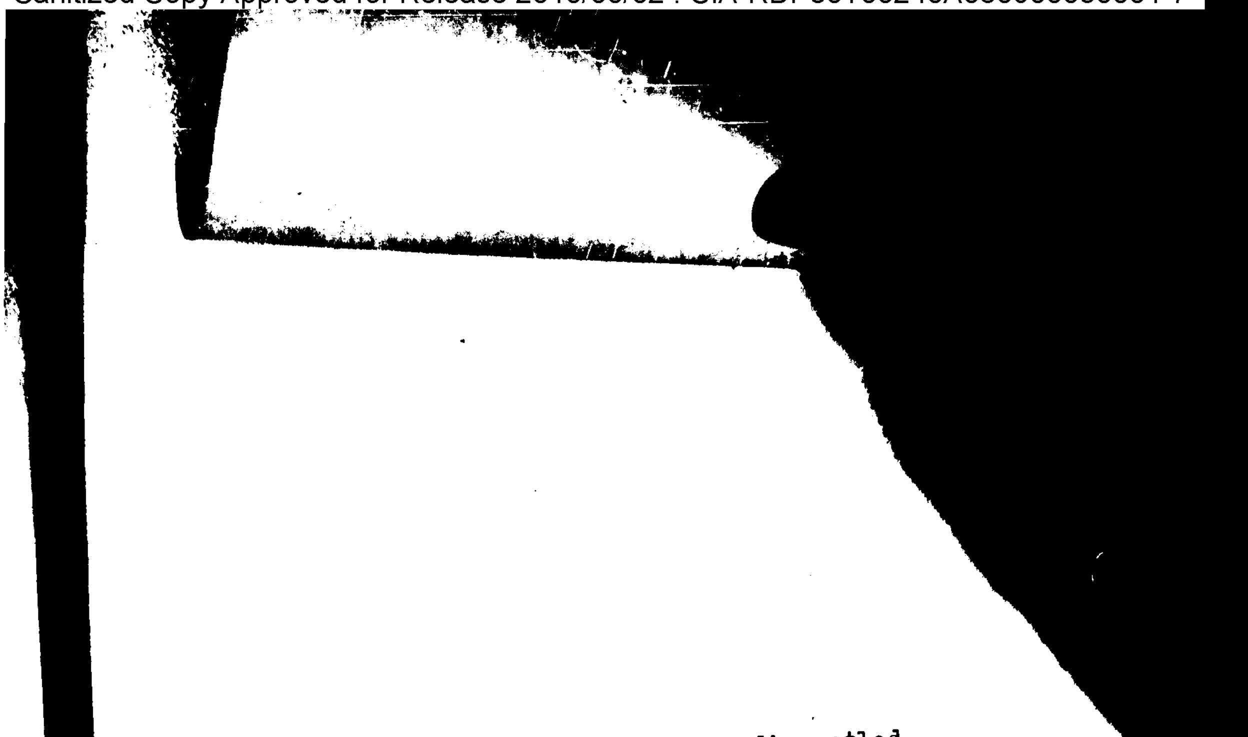


Fig. 37 - Upper plate,partially dismantled

The gear wheel 18, mounted in the guide,serves for transferring to the gear wheel 21 the rotation from the shafts for introducing the angles q and ε. The compensating resistors JUS-50,JUS-200, JUS-1000 4 (see Fig.35) are connected into the electrical computing bridges. By means of these resistors the sight is adjusted in the factory.

The bracket 27 (see Fig. 37) serves for mounting the potentiometers 28,29 (see Fig. 35,37). The holes in the bracket serve as a guide for the racks with links 30, 31.

The bracket 32 (see Fig.35) carries fixed resistors 33 of 100 Ohms each, connected in the electrical computing bridges.

In addition to the mentioned parts mounted on the lower and upper plates details are interposed between them,uniting the upper and lower plate kinematically.

The differential 34 (see Fig.35,36) transfers the summary angle from the drives of q and ε to the gear wheel 18 (see Fig. 37). The bevel wheel 35 (Fig.36,38) and the spur wheel 37 transfer the rotation from the shaft 10 of the drive of ε to the differential and gear wheel 24.

Wheel 11 rigidly fixed to the shaft 10 will follow each rptation of this shaft through an angle ε.

... angle ε is transfered over the bevel gear 11 - 35 to the spur gear 37 - 24. The gear wheel 24 (see Fig.37,38) is rigidly attached to the gear wheel 21. This konematic train is calculated in such a manner that at the rotation of the shaft through an angle φ, gear wheel 21 and also guide 22 with the pin 23 rotate through the same angle φ.

The pin 23,fitting into the slot of the link 30,moves the rack through a distance r cos φ (where r is radius of the crank). The rack attached to the link 30 meshes with a gear wheel 38 of the potentiometer 28. Since the gear wheel 38 is fixed to the spindle of the potentiometer 28, it is evident that the sliding contact will turn through the same angle as the gear wheel 38. The rack attached to the link 30 meshes with the gear wheel 38 in such a way that for zaro position of the krank the sliding contact of the potentiometer 28, introduces a resistance of 10 ± 1 Ohm.

As the link 30 moves through a distance r cos φ, the gear wheel of the potentiometer turns through an angle proportional to r cos φ which results in a change of the current in the sighting bridge in proportion to cos φ.

In this way the cosine device,mentioned above,moves the sliding contact of the potentiometer slide in accordance with the law cos φ and consequently also the current in the circuit of the sighting bridge will be subject to this change.

The potentiometer 28 in the circuit of the sighting bridge is marked R_1 and is called SIGHTING POTENTIOMETER.

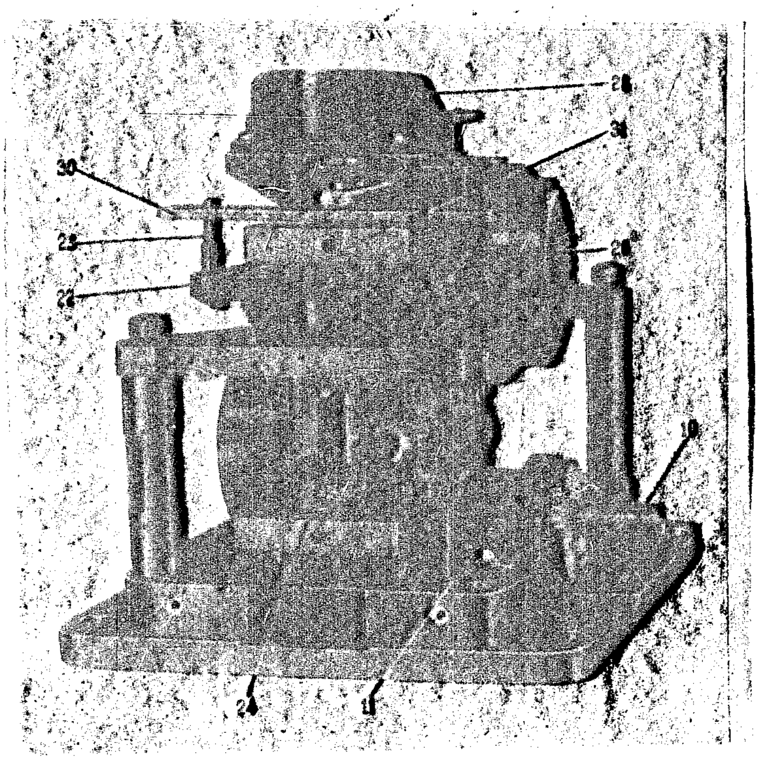
For adjusting the zero position ($\varphi = 0$) of the cosine device, the limiting plate 13 (see Fig.35) and the index have adjusting marks.

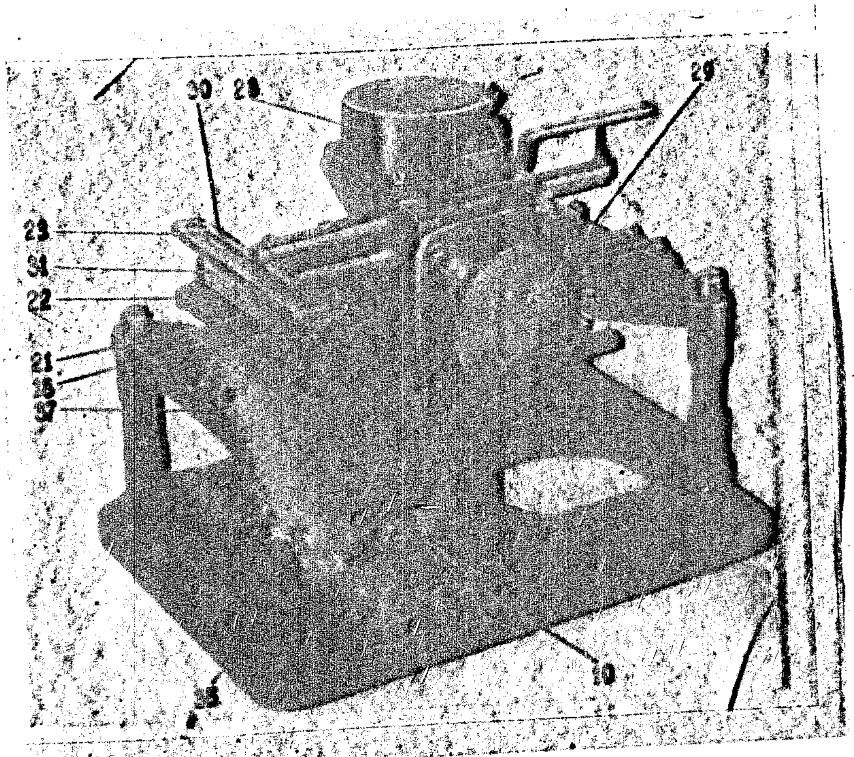
When investigating the cosine device it was found that when the shaft 1o rotates (see Fig.37,38), the gear wheel 21 revolves through the same angle φ. Thus the gear wheel 18,which is coupled with the gear wheel 21,revolves together with it as one whole,as they revolve with the same velocity.

The pin 26 of the crank which fits into a slot of the link 31,therefore moves in a circle and moves the link through a distancer sin φ, (where r is radius of rotation of the pin).

In addition to this,during the rotation of the shaft 1 (Fig.36, 37,39) through an angle q the gear wheel 18 is moved through the same angle by the differential at the same time rolling along the internal gear wheel 21. The geared wheel 18 therefore revolves

Fig. 38 - 39 ....page 59





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ound its axis through an angle of 2 q. The pin 26 of the crank oves along a straight line pushing the link 31 and consequently lso the rack through a distance r cos q (where r is radius of otion of the pivot).

At the simultaneous introduction of angles q and the rack moves through a distance r cos q sin .

The link 31 with the rack engages the gear wheel of the potentiometer 29.

Since the gear wheel of the potentiometer is mounted on its, it is evident that the sliding contact will move through the same angle as the gear wheel of the potentiometer.

The link 31 with the rack engages the gear wheel of the potentiometer in such a way that if q=0 and =0, the sliding contact divides the resistance of the potentiometer into two equal parts.

When the rack 31 moves through a distance r cos q sin , the gear wheel sitting on the potentiometer spindle revolves through an angle proportional to r cos q sin , thus changing the current in the vertical lag bridge in proportion to the product cos q sin .

The considered device in this manner moves sliding contact in accordance with the law cos q sin . The current in the circuit of the horizontal lag bridge will also change in accordance with the same law.

The potentiometer 29 in the circuit of the vertical lag bridge is marked R_1 and is called vertical lag POTENTIOMETER.

a) POTENTIOMETER.

Potentiometers used as resistance elements in the electrical bridges of the sight are either used as voltage dividers ($R_{1\ v}$; $R_{1\ h}$; $R_{1\ z}$) see Fig.11) or as rheostats ($R_{11\ v}$; $R_{12\ v}$ etc.see Fig.26).

In addition to the potentiometers performing computing operations int the electrical bridges,adjusting potentiometers are used (compensating potentiometers JUS-50, JUS-200, JUS-1000).

The resistance variation of all potentiometers and rheostats used in the sight ASP-3P in proportional to the angle of rotation of the sliding contact so called "linear" law potentiometers.

tentiometers are divided into several groups,according to their se. The type of the potentiometer and the resistance of its are marked on the cover (e.g. PD-160).

ntiometer winding is made of enamelled constant wire wound on a lacquered metal (aluminium) ring. The angle subtended by the winding is 344 ± 4°, the largest operating voltage 30 V ; maximum power dissipation in the whole winding 5 W.

The ring with the winding 1 (Fig. 40, 41) is pressed into a metal sleeve 2 into a quartz cement, which insulates the winding from the body and ensures good thermal conductivity, i.e. the cooling of the potentiometer winding. The sliding contact 3 is fastened to the spindle 4, placed in the potentiometer body.

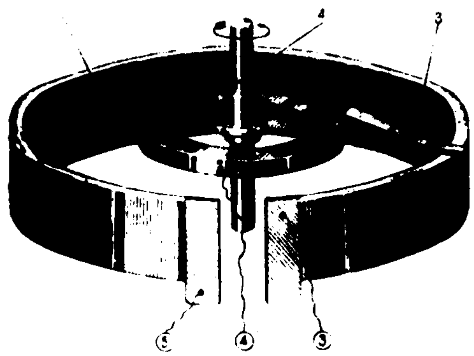


Fig. 40. Ring with winding and sliding contact.

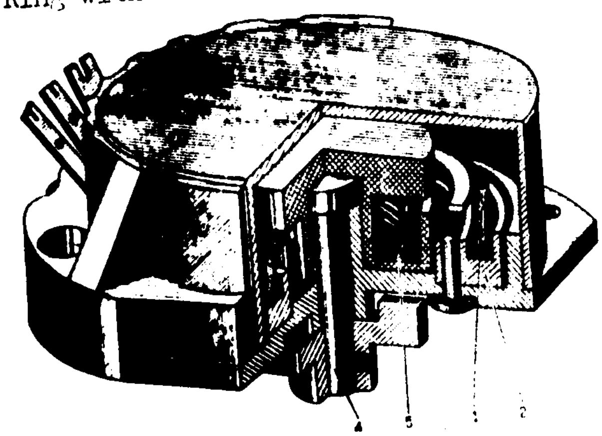


Fig. 41. P o t e n t i o m e t e r .

As the spindle 4 turns, the silver contact of the sliding contact slides along the top part of the ring carrying the potentiometer winding (the enamel is taken off the wire on the surface of slip) with a constant contact pressure of 7-10 g.

Three numbered terminals "3", "4", "5" for soldering into cir- ... are fixed to the body.

... to the sliding contact is accomplished by means of ..., which at the same time reduces the clearance between the potentiometer and the drive.

The angular shift of the sliding contact is limited by two mechanical stops, placed on the body and on the spindle. The body is fixed to the frame with screws.

b) ADJUSTING RESISTORS.

According to their ohmic resistance, adjusting resistors are divided into three groups - JUS-500, JUS-200, JUS-1000. The value of the ohmic resistance is marked on the cover.

The winding is made of an enamelled constantan wire wound on a lacquered metal (aluminium ring.)

The angle of winding is $300 \pm 4^{\circ}$.

The ring with the winding 1 (Fig. 42) is fastened to the body with a quartz cement.

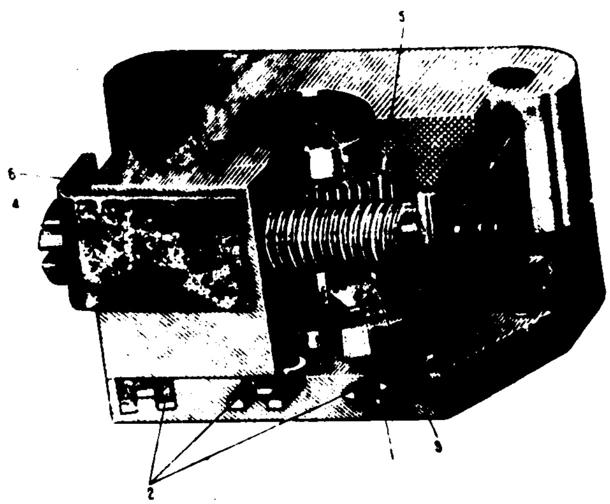


Fig. 42. Adjusting resistor.

Three numbered terminals 2 for soldering the connecting wires are fixed to the body.

In this potentiometer the brush 3 is moved along the ring carrying the winding 1 by means of an adjusting screw 4 and worm pinion 5. The adjusting screw 4 is pressed by the spring 6 in the direction of its axis towards the body and in a radial direction towards the worm pinion 5, owing to which backlash is completely eliminated. The adjusting screw has a shoulder into which fits the above-mentioned ... eliminates the necessity of locking the adjusting screw after adjustment). The motion of the sliding contact is limited by a mechanical stop.

Two dots on the body, mark the beginning and the end of the winding; the worm wheel carries a mark, which shows the position of the brush.

4. SPEED MECHANISM.

From the dependances, expressed by the formulas , it is evident that the v a l u e o f a n g l e o f lag is p r o p o r t i o n a l t o t h e p l a n e ́s o w n v e l o c i t y.

The speed mechanism serves to introduce the plane own velocity into the electrical computing circuits of the lag bridges of the sight. The lag is determined by a change of the resistance of the potentiometer $R_{11\ h}$; $R_{12\ h}$; $R_{11,v}$; $R_{12\ v}$; see Fig.11), connected in the diagonal of the lag bridges.

The potentiometers $R_{11\ h}$ and $R_{11\ v}$ of type PD-160 are transmitting potentiometer with a resistance of 160 Ohms. The potentiometers $R_{12\ h}$, $R_{12\ v}$ are transmitting potentiometers with a resistance of 400 Ohms. The intesity of the current,passing through coils of vertical and horizontal lag is thus changed proportional to the plane own velocity.

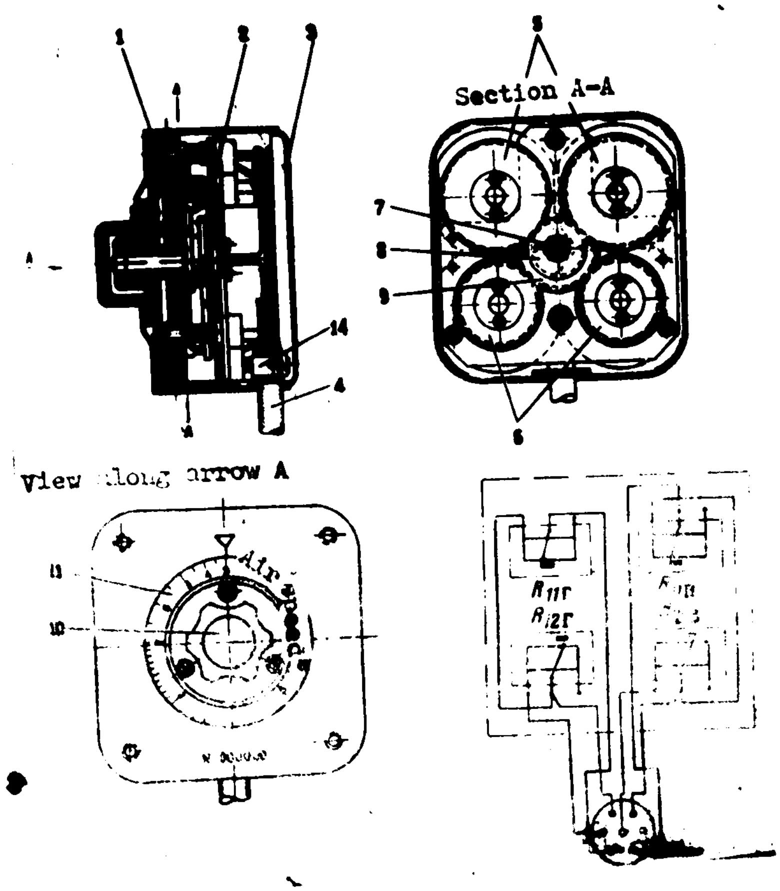
The design of the speed mechanism is illustrated in Fig,43.

The speed mechanism consists of a base 1, to which a plate 2 with four potentiometers is attached, the case 3 and cable 4,by means of which the mechanism is connected to the junction box. The spindles of the potentiometers are fixed with spur wheels 5 and 6. Through the centre of the base a spindle 7 passes, to which two spur wheels are fixed, engaging the potentiometers spur wheels and carrying the control 10.

The control carries the dial 11 marked with the plane ́s own velocity. The base carries an index. By turning the control 10, the plane ́s own velocity is set to the index. Simultaneously with the control the sliding contacts of the potentiometers revolve by means of the geared wheels 8 and 9 introducing resistance proportional to the required velocity.

The potentiometers are connected into the electrical circuits of horizontal and vertical lag bridges by means of leads from the cable 4. The cable is attached to the bracket,14, fixed inside the mechanism.

Fig. 43.....page 64



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The end of the cable carries a seven-pin male connector 12 (Fig.44) with the inscription "Velocity", inserted in the female connector marked by "Velocity" on the junction box.

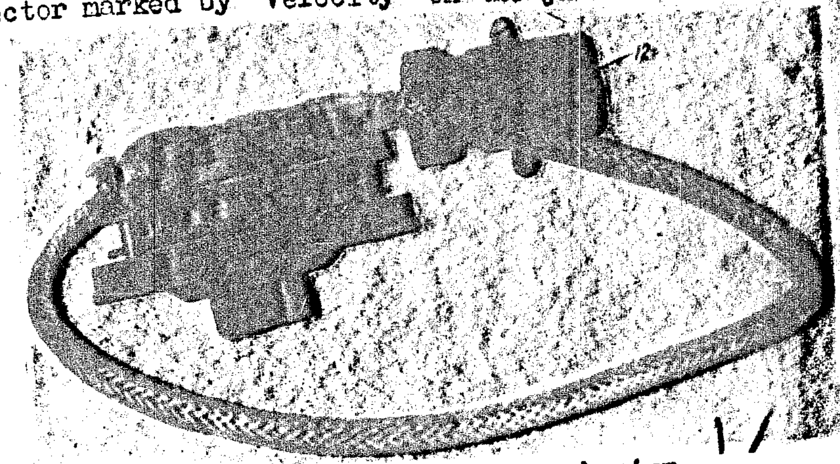


Fig. 44. Speed mechanism.

The dial of the speed mechanism is marked "Air speed km/h". The speed ranges from 300 to 900 km/h. The scale is non-uniform :from 300 to 700 km/h the graduations are for every 50 km/h,from 700 to 900 km/h for every 10 km/h.

If the index shows the plane's own velocity to be 300 km/h,the resistance,to which the potentiometer PD-400 is set,must equal 32,6 + 0,5 Ohms; for a velocity of 900 km/h. it is 10 ohms. The plane is engraved with the same number as the sighting head.

All the inscriptions and marking are made in white paint. The appearance of the mechanism with the cover taken off is illustrated in Fig. 44.

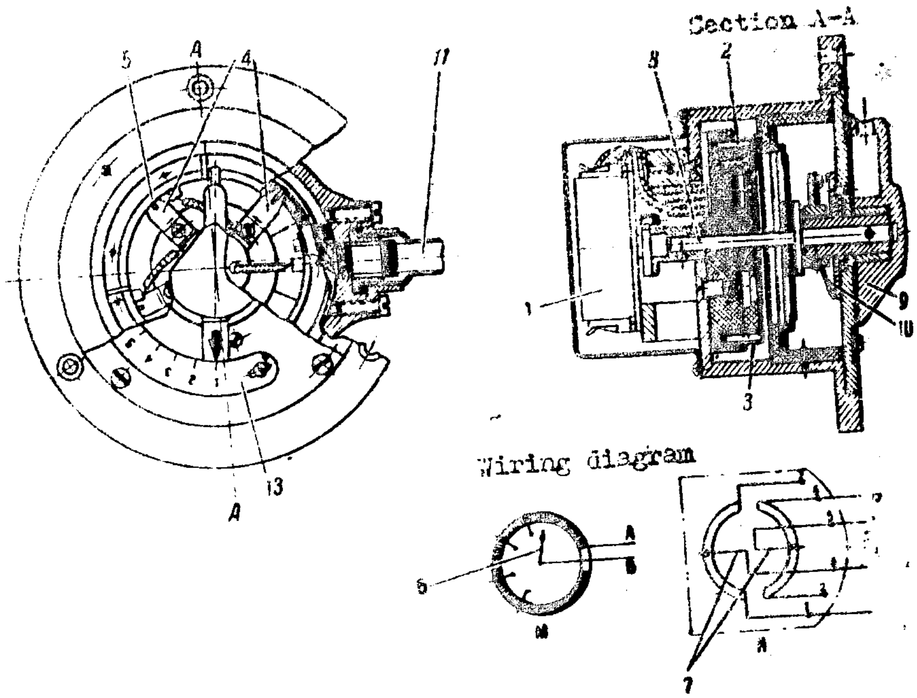
5. ALTITUDE MECHANISM

The altitude mechanism serves to introduce the altitude of flight of the plane into the electrical computing circuits of the lead and lag bridges.

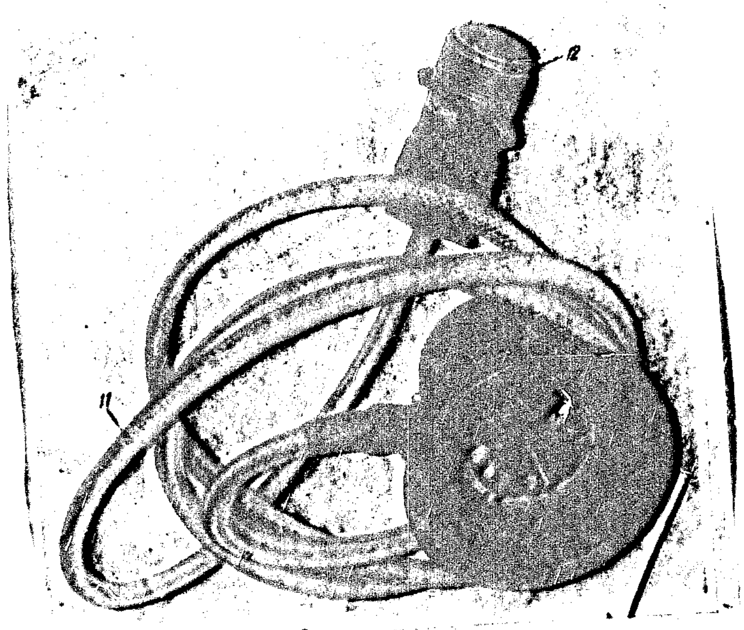
The introduction of altitude is performed by the variation of the resistance of the potentiometers $R_{20\,v}$; $R_{20\,h}$ (see Fig.11), connected in the diagonal of lag bridges, as well as by a change of the resistance of the shunts R_{04} to R_{08} of the lead circuit rheostat.

The design and appearance of the altitude mechanism is illustrated in Fig. 45 and 46.

Fig.45 - 46 ....page 66



Altitude mechanism



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The mechanism consists of the potentiometer 1 and resistor which hunt the range rheostat of the lead circuit. The potentiometer 1, onsisting of two halves, is connected in the diagonal of the horizontal and vertical lag bridges.

The resistor 2, shunting the range rheostat, consists of a frame ith the winding 3 (1300 Ohms) and five contact strips 4. Each of he strips can be shifted during the adjustment of the sight along he winding and it is possible to establish the required values of he shunt resistances.

These movable strips are connected to the sectors 5, each of hich corresponds to a certain range of altitudes.

The average values of the resistances for the various altitudes re as follows :

Altitude m	Resistance Ohms
1000	1200
2000	600
4000	350
6500	150
10000	50

The potentiometer consists of two halves with 500 Ohms each. The esistor and potentiometer have sliding contacts 6 and 7, one of hich moves along the sectors, the other along the potentiometer inding; the sliding contacts sit on a common spindle of rotation 8, his spindle also carries the altitude control 9, and the indexing atchet 10.

When setting the altitude control to a certain value, the sliding ontacts 6 and 7, mounted on its spindle rotate and introduce certain alues of shunt resistances and resistances of the potentiometers, onnected in the diagonal of the lag bridges.

The potentiometer 1 and resistor 2 are connected into the sighting ircuits by means of leads from the cable 11. At its end the cable arries a seven-pin male connector 12 (see Fig.46) marked with the nscription "Altitude", it is inserted into the female connector marked "Altitude" on the junction box. The cover is fixed with a graduated escutchs on 13 (see Fig.45), which can be slightly shifted when adjusting the whole sight equipment. The scale is non-uniform and carries an inscription "Altitude km".

6. JUNCTION BOX.

The junction box serves for the electrical inter-connection of all ne units of the sight equipment. In addition it contains adjusting esistors R_d; R_{o1}; R_{o9}; R_{1o} (see Fig.11), by means of which the ight is adjusted in the factory.

The appearance of the junction box, with the cover removed, is llustrated in Fig. 47.

Fig. 47- Junction box with the cover removed.

In the body I a "carbolite" terminal strip 2 is fixed, to the terminals of which are attached the leads from the individual cables, coming from the separate units of the sight. The cables themselves are fastened to the junction to the box body with clips 3. Each cable is fixed at its end with a female multiple-pin connector the body of which carries the inscription of the mechanism, with the connector of which it is to be connected.

The connector of cable 4, marked "Sighting-head", is connected to the connector of the sighting head cable.

The connector of cable 5, marked "Rheostat" is connected to the connector of the range rheostat cable.

The connector of cable 6, marked "Altitude" is connected to the ... r of the altitude mechanism cable.

The connector of cable 7, marked "Computor" is connected to the connector of the computing mechanism cable.

The connector of cable 8, marked "Button" is connected to the connector of the cable marked "Button".

The connector of cable 9, marked "Speed" is connected to the connector of the speed mechanism cable.

The cable 10 is connected to the voltage regulator. The attachement of separate conductors to the terminals of the terminal strip is performed according to the wiring diagram (Fig. 48).

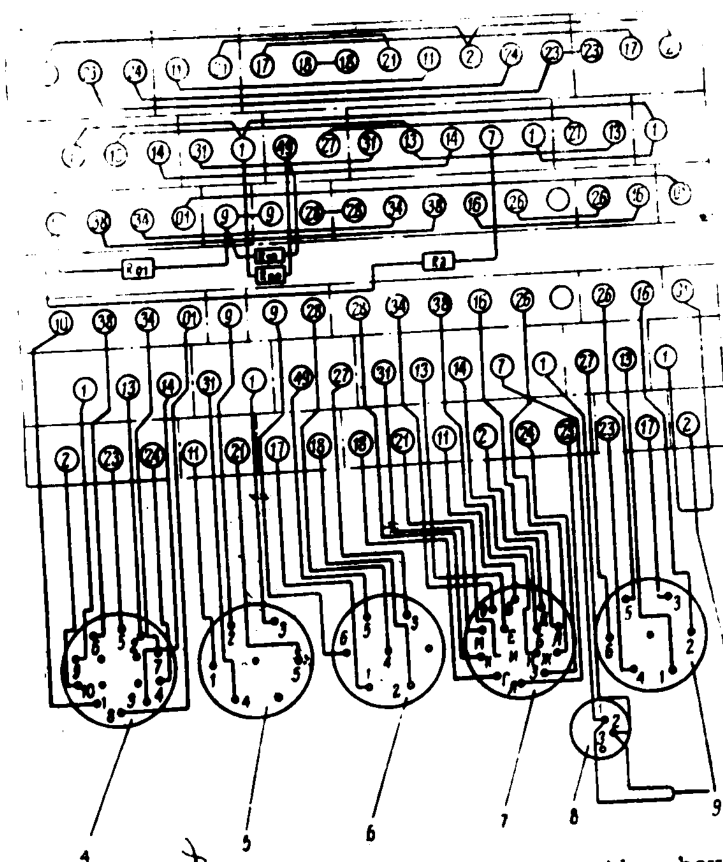
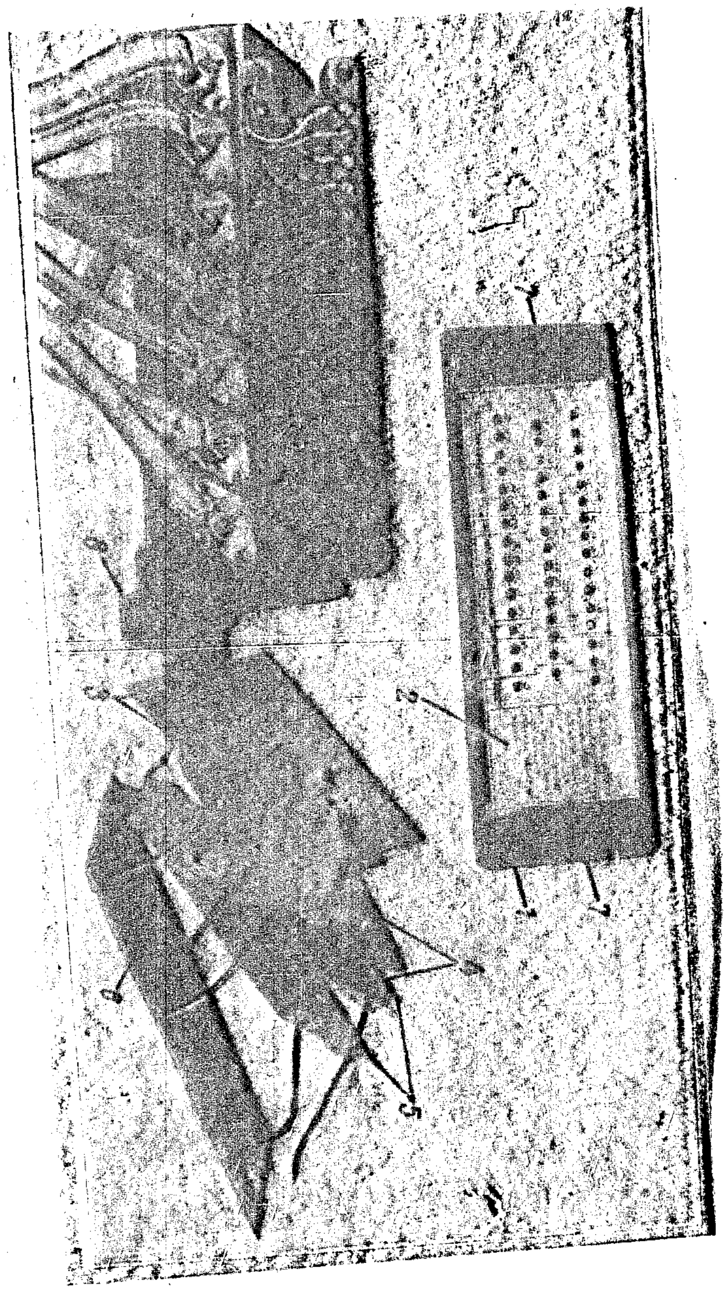


Fig. 48. Wiring diagram of the junction box.

A diagram 2 of the junction box is pasted on the side of the cover (Fig. 49).

Fig. 49....page 70



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It should be born in mind that the n u m b e r of the l o a d m u s t c o i n c i d e w i t h the n u m b e r of the t e r m i n a l with which it is c o n n e c t e d.

At the bottom of the terminal strip the terminals are inter-connected in accordance with the wiring diagram (see Fig.48). Here the adjusting resistors are also soldered into place.

The adjusting resistors are assembled into a pack and are fixed in the bottom of the junction box. The pack consists of two insulating plates 3 (see Fig. 49) wound with resistance wire 4, insulating layers 5 and a metal plate 6, by means of which the whole pack is attached to the body.

The box is closed with a metal cover 1,which is attached to it with two nuts 7. Two brackets with holes are screwed to the bottom of the box. These brackets serve to fasten the junction box to the plane.

7. VOLTAGE REGULATOR

The carbon voltage regulator of the type RNU is intended to maintain the d-c voltage feeding the sight within 22 ± 0,75 V, for input voltage fluctuations of 27 V ± 10% and for changes of load of 0,5 to 1,9 A.

The voltage is illustrated in Fig. 50 and 51.

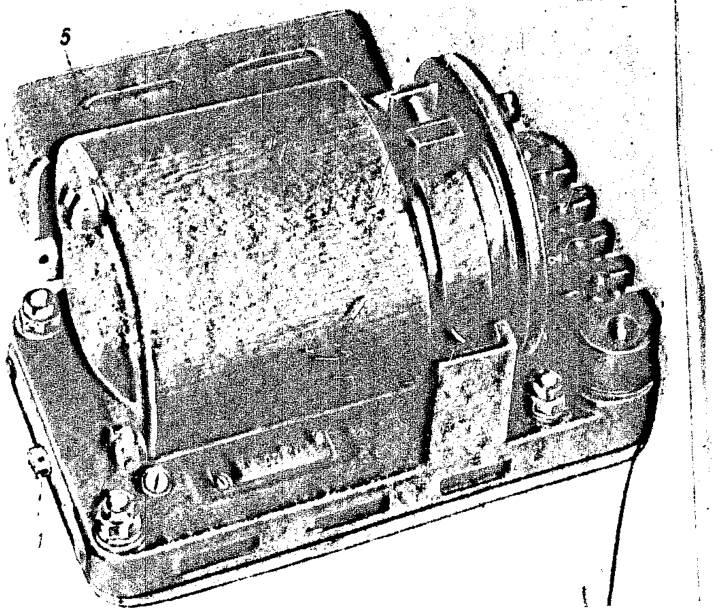
The operation of the regulator is based on the principle of a change in the resistance of a carbon column according to the pressure applied to the plates forming the column. For small pressures the resistance is large while for large pressure it drops.

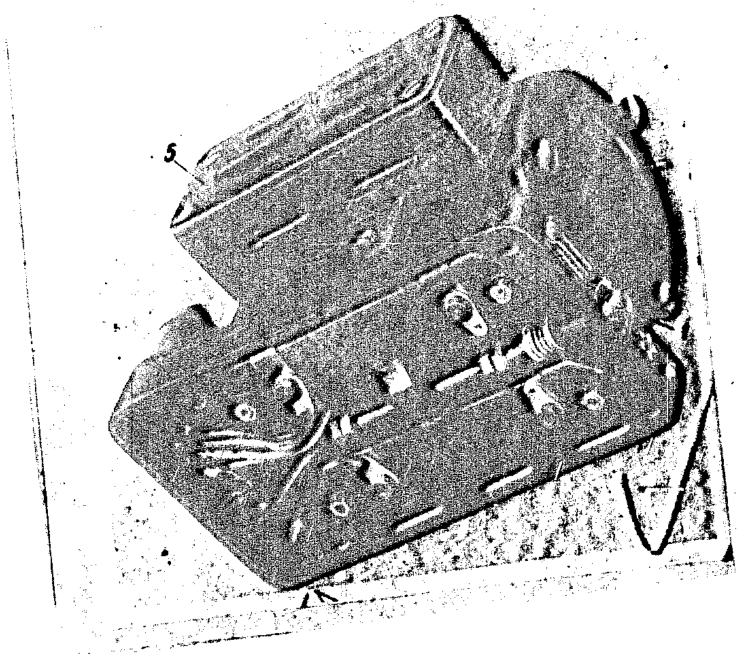
The sensitive element which responds to the fluctuations of output voltage,is an electromagnet to the winding of which the output voltage is connected. The magnitude of the output voltage can be adjusted by an adjusting resistor (Fig.51.52).,connected in series with the electromagnet winding. The adjustment is carried out by a screw 1, brought out at the front. Inside the winding 2 (Fig.52) of the electromagnet a yoke 3 is placed. The pressure on the carbon column which consists of single discs 7, depends on the varying value of the attractive force of the yoke of the electromagnet and the counteracting spring 4.

The regulator is provided with temperature compensation.

A load resistor 5 (Fig.65,66,67), connected in the regulator

Fig.50,51,52,....page 72,73,





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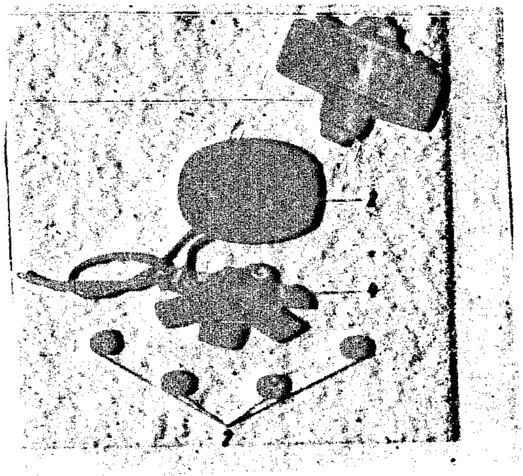

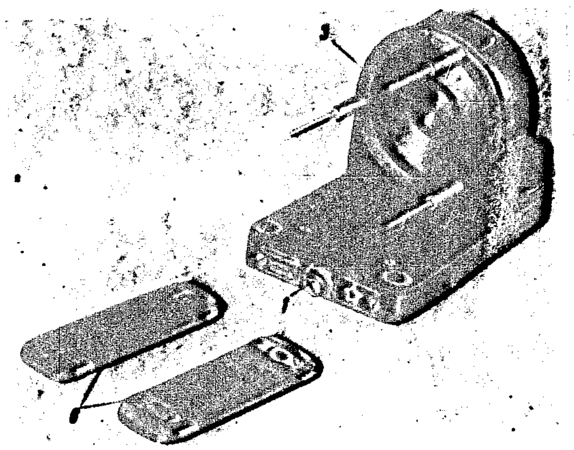

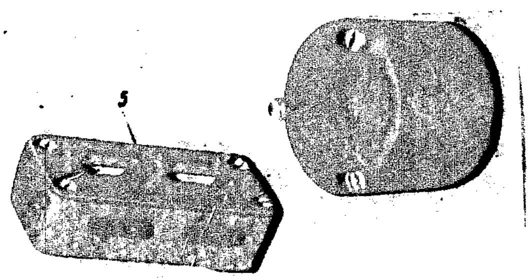

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circuit,acts as a bleeder when disconnecting the computing circuits of the sight.

The input and output leads are connected to the terminals,placed on the opposite side to the adjusting screw abd numbered from "1" to "4". The input voltage is connected to the terminals "1" and "3", the output voltage is taken from the terminals "3" and "4".

The voltage regulator is adjusted in a horizontal plane,with its longitudinal axis perpendicular to the longitudinal axis of the plane so that free access to the adjusting screw is ensured.

8. WIRING DIAGRAM OF THE SIGHT.

Fig.53 illustrates the wiring diagram of the sight. The dot and dash-lines enclose the separate units of the sight: sighting head, range rheostat, computing mechanism, speed mechanism,altitude mechanism, junction box,voltage regulator. Cables are shown by strong unbroken lines, male and female connectors by circle bearing the same numbers as the contacts of these connectors. The "carbolite" plate plate of the junction box is represented in two ways:from above, i.e. as seen after removing the cover, and from below,i.e. turned through 180°, with all the wiring between the terminals.

The leads are marked in the same way as in the main diagram (see Fig.11).Number 1 marks the positive lead,number 2 the negative lead.

Let us consider the following example.

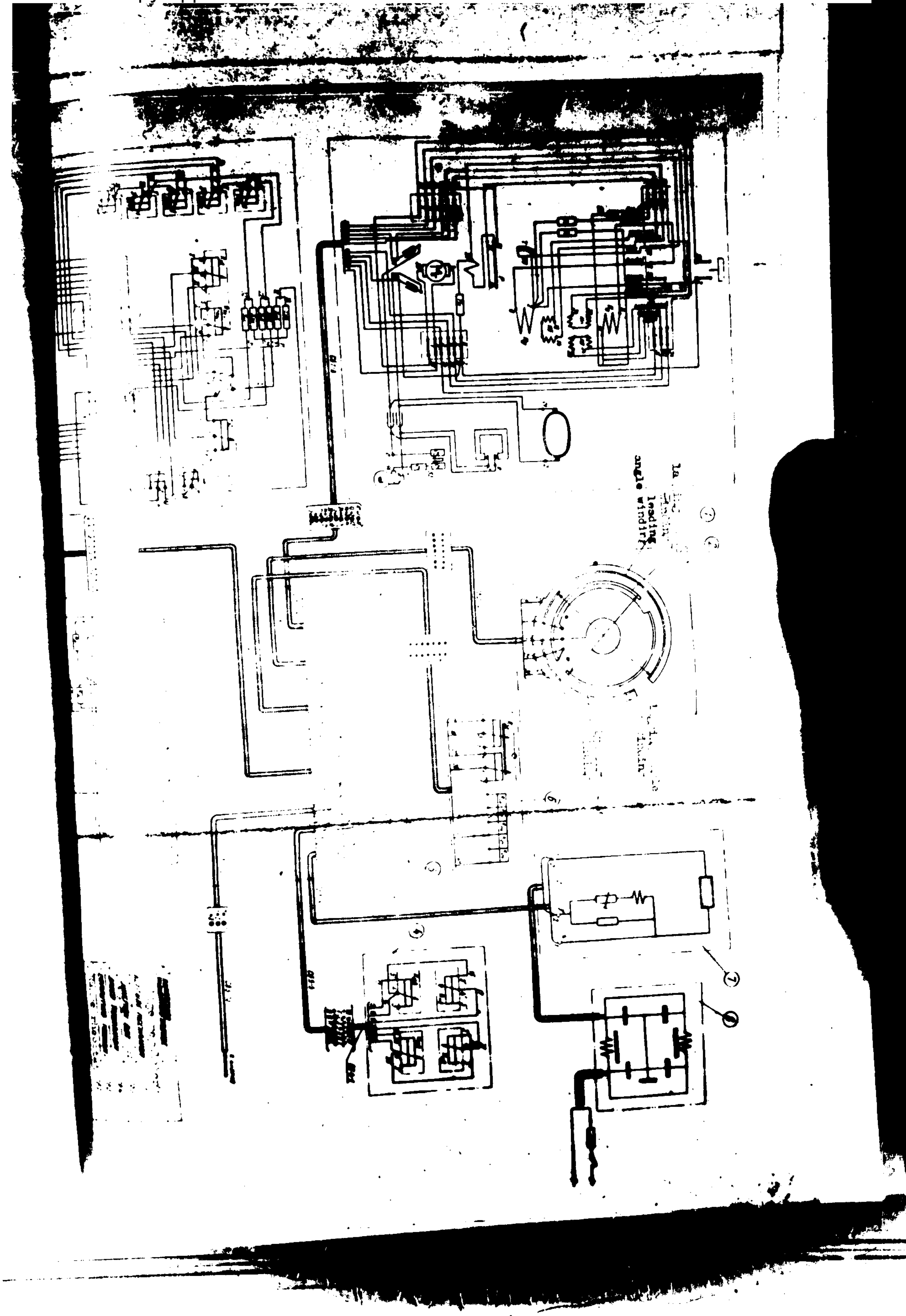
On the main diagram the number 2 marks all conductors, leading to the heating elements of the optical system, to the lamp,motor and lead coils.

Conductors, connecting negative voltage to the quoted assembly, are marked on the wiring diagram with the same number 2. On the wiring diagram in the sighting head the conductor connecting the heater resistances O_2 and O_3 is marked with the number 52 and on the main diagram the same number marks the conductor connecting the resistances O_2 and O_3.

The smae numbers of the conductors are also marked on the terminal strip in the junction box on the wiring diagram; and in the box itself the numbers are marked on the carbolite plate.

On the diagram of the sighting head both the left and right ...al strips, placed on the front cover marked with thick hori-

Fig.53....page 75



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zontal lines,are numbered from 1 to 6.

The whole wiring diagram is carried out with a view to represent as closely as possible the actual character of the sight.

In the junction box diagram all adjusting resistors and shunts are marked- The resistance of these resistors is set during the adjustment of the sight.

V. OPERATION OF THE SIGHT

I. LOCATING AND MOUNTING OF THE UNITS OF THE EQUIPMENT INSIDE THE PLANE

When mounting the sight in the plane it is necessary to remember that after the sight is adjusted,the sighting head,computing mechanism, altitude and speed mechanism and the junction box are an integral whole and are therefore numbered with the same number. The same number is marked on the packing case and written down in the certificate of the sight.

As already stated, the sighting head is produced in the factory fixed the range rheostat and it is not recommendet therefore,if not inevitably necessary, to separate the range rheostat from the sighting head.

The assembly diagram of the sight is illistrated in Fig. 54. It shows the mechanical and electrical connection of the individual units of the sight.

The set of the sight is mounted in the gun turret IL-K 6,forming the rear turret remote control with feed-back.

The main part of the installation is the control panel ,which serves for the remote control of the motion of the gun,for synchronizing the motion of the gun with that of the sighting head,for introducing the range, deck angles and angles of elevation of the gun to the computing mechanism of the sight and for the control of fire.

The sighting head,control levers and transmitting potentiometers are mounted on the control panel. The sighting head must be adjusted in such a manner that when in a normal position, it should be not more than 250 mm from the gunner's eye.

On the right side of the sighting head bracket is a plate to which the computing mechanism is screwed with bolts. The splined shaft for introducing the deck angles of the gun to the computing

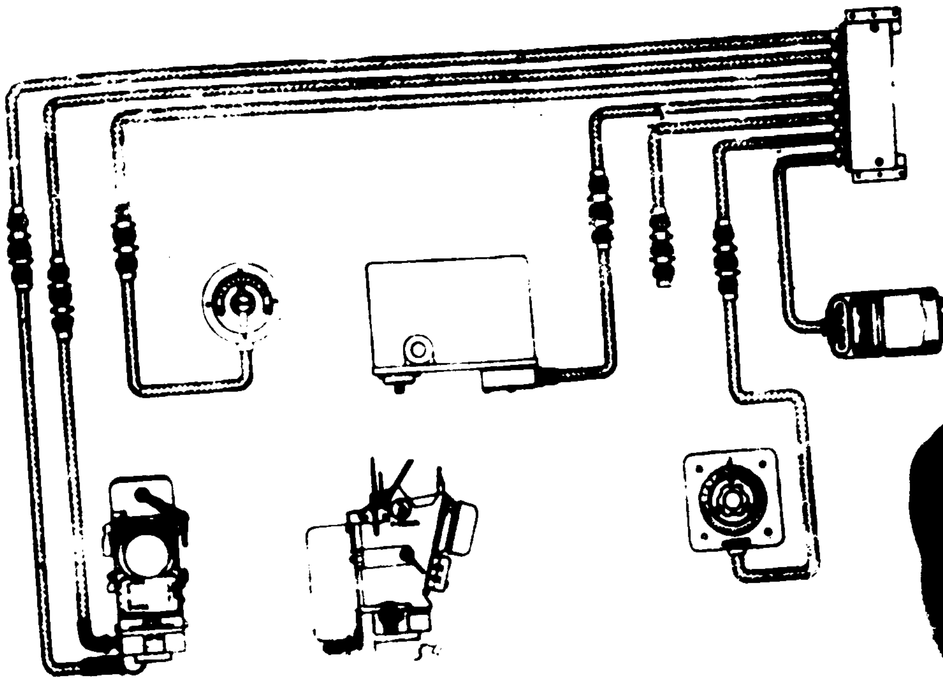


Fig. 54. Assembly diagram of the sight.

mechanism must fit into the corresponding grooves of the reduction gear shaft on the turret while to the shaft for introducing the ang of elevation a toothed sector is fixed,which meshes with the feed-back sector of the turret. When installing the computing mechanism o the panel the shafts of the first have to be set to their respective zero positions (zero positioning of the shafts is accomplished by coincidence of the marks.

All controls,catches and connectors must be accessible. The dial of bases must be well visible,the approach to the illuminating bulb free.

The lower part of the bracket contains a pulley which is joined by a steel cable to the left control lever which serves for introducing the range into the sight. The pulley has a spring loaded pin by which it is coupled to the range rheostat.

The pin on the pulley fits into the groove of the rheostat drive; when installing the sight the drum should be turned in such a way the figure "2" on the range dial should stand opposite the index ...ly.

... left side of the sighting head bracket there is an opening for letting through the cable of the range rheostat. The bracket is fixed in a threaded bush, permitting the bracket during shooting test to be adjusted relative to the sighting head through 4 - 5° in any direction.

The left control lever on the panel has a pulley with a steel cable. The cable is enclosed in a bowden casing and connects the lever with the pulley of the sighting head bracket.

As the lever is revolved the cable actuates the range rheostat drive and thus the range is introduced into the sight.

To the left of the gunner there is a panel on which the altitude and speed mechanism are mounted. The junction box and the voltage regulator are fixed to the same side. As shown in the diagram, cables are brought to the junction box from all units of the sight; from the junction box a cable goes to the damping button, mounted in the left lever of the control panel.

The socket for control measurement of the stabilized voltage 22 ± 0,75 V is connected to the terminals "3" and "4" of the voltage regulator.

2. GENERAL OPERATING INSTRUCTIONS

The sight ensures an effective use of the gun. Therefore it is among the most essential equipment of the plane and must be subject to incessant care and attention by the technical staff and air crew.

Persons operating the sight must bear in mind that the sight is an accurate and very sensitive electrogyroscopic mechanism, which requires very strict observation of the operating instructions and careful treatment.

As a rule the sight is kept fixed in the plane to the turret and must be protected with a cover from dust, moisture and the sun.

The arresting lever must be in the "Nepod" (arrest) position

The switch "Pritsel" (sight) must be switched off.

The sight when removed from the plane (to be transported or re-[illegible]) must be kept in the packing case where it is fastened), [illegible]-absorbing plates. This also concerns all units of the [illegible] the whole equipment is removed .

N O T E :1)The device operates correctly only with direct current and an input voltage of 27 V ± 10%,which must be ebsured.

2)The cable connectors must be connected according to the inscriptions placed on them (male connector ("Sighting-head")with the female connector "Sighting-head",connector "Rheostat" with the connector "Rheostat" etc.)

3)It is necessary to carry out in time and at regular intervals a) inspections,checks and adjustments ;
b) entries into the certificate;

4)It is categorically forbiddem !
a) to operate the sight without having previously read the technical description ;
b) to install and use the junction box,sighting head altitude and speed mechanism and computing mechanism marked with different numbers.

The following facts should further be born in mind:

1). S w i t c h i n g to " N e p o d " and S w i t c h i n g the t o g g l e s w i t c h " S i g h t ".

On the base,when towed,taking off and landing or during the flight when not operating the sight,the lever of the arresting mechanism on the sight must be set to "Nepod" (lowered). If the use of the sight in the air is not anticipated,the toggle switch "Sight" is switched off both on ground and in the air. If the use of the sight is anticipated, the toggle switch "Sight" has to be switched on at least 15 minutes before the use of the sight (it is possible to do so immediately after take-off.

This time is necessary to heat up the voltage regulator as well as to obtain a constant temperature in the sight (about 50°C), required for its proper operation.

2). S w i t c h i n g to "G y r o ".

It is possible to switch the sight to "Gyro" immediatelly before the use of the mobilegrid, allowing 2-3 seconds for "calming down the grid". In order to switch on the sight,the lever of the arresting mechanism is set to "Gyro" (raised).

Operation of the sight in the air.

... operating the sight it is recommended to carry out successi... following operations:

1).When entering a zone of possible encouter with the enemy:

a) switch on the sight

b) set the control 3 of the speed mechanism (Fig.31) to the plane's own velocity.

c) Set the control 9 in the altitude mechanism (Fig.32) to the altitude of the plane's flight.

When doing this, the gyroscope must be arrested (the lever of the arresting mechanism must point to the inscription "Nepod".

2).On sighting the target :

a) adjust target's dimensions on the dial of bases on the sighting head (according to the type of plane);

b) readjust the speed mechanism with greater precission to the plane's own velocity;

c) readjust the altitude mechanism with greater precission to the altitude of flight;

d) free the gyroscope (set the lever of the arresting mechanism opposite the inscription "Gyro").

In order to enhance the determination of the position of the lever (position "Gyro" the side of the arresting lever turned towards the gunner is painted white.

3).Begin to follow the target by moving the sight. Try to make the centre point of the grid coincide with the target and at the same time frame the target with the range-finder circle. The latter operation is performed by turning the range control.

4).Turn the turret smoothly while following the target so as to prevent the centre point coming off the target.

5).Continuously rock the range control while following the target and keep the outline of the target framed within the range-finder circle (i.e. the ring formed by the inner ends of little rhombs).

When at least 1 second has elapsed from the beginning of the correct following up of the target (which is framed with a range-finder circle open fire, while continuing to follow the target.

REMEMBER ! Correct sighting can be attained only if the size of the target is correctly established and if the target is framed by the range-finder circle.

N O T E : During an air-fight it may happen that at large angular speeds of the turret, when throwing over the gun, the gyroscope strongly vibrates and the image of the range-finder circle may get outside the field of vision. Such a sudden disappearance of the grid can disorientate the gunner. In order to prevent this,it is recommended to press the damping button placed on the distance lever during sudden turns of the sight. Thus the maximum current will pass through the range coil and the gyroscope, as well as the image of the range finder circle,will deviate from the axis of the gun only insignificantly. As soon as the target is again sighted the damping button is released and the sudden turn interrupted.

2. During air-fights at close quarters (under 100 m) it is recommended to use the stationary grid,for this it is necessary to switch the lever of the arresting mechanism position "Nepod". Thus the image of the grid will become stationary. In this case the gunner must sight as with a usual collimator sight and use a dashed constant diameter circle and the centre point.

The dashed constatnt diameter circle must also be used in case of failure of the automatic equipment of the sight.

Should the optical system or electrical illumination fail,the gunner must use the mechanical sight,bringing it into the working position by depressing the catch.

5. When the air-fight is ended,arrest the gyroscope and switch off the sight.

3. INSPECTION BEFORE AND AFTER THE FLIGHT

a) Inspection before the flight.

When preparing the flight, before starting the engine,an inspection should be carried out.

During e x t e r n a l i n s p e c t i o n and direct examination it is necessary to make sure whether:

a) the lens, semi-transparent mirror and filter are not covered with dust,impurity or grease (when sleaning the said optical details, proper care should be observes,so as to avoid damaging them) ;

b) the semi-transparent mirror and filter are reliably fastened and are not loose ;

c) the filter is by means of the lever 17 (see Fig.30) easily [illegible] into or removed from the field of vision;

[illegible] illumination control (see Fig. 19) revolves easily from [illegible] the other without excessive strain and that it is re[illegible] any position ;

e) when revolving the protective cushion 14 (see Fig.19) the dial of bases 15 is easily shifted with respect to the index over its whole range (from 7 to 45 m) and is reliably adjusted in any position ;

f) the cover of the lamp case 16 (see Fig.19) is easily opened and closed by the catch ;

g) the mechanical view-finder 6 (see Fig.19) is in order and is reliably set to the upright position ;

h) silicagel, visible through the glass of the observing window of of light-blue colour ;

i) range control and steel are correctly adjusted. When turning the lever towards oneself the range dial drum stops in a position corresponding to less than 180 m, and the drive and the belt-pulley move an additional 14°, approximately (during the bases should be adjustable in the range from 14 to 22 m);

j) the range control revolves easily, smoothly, without jerk, from the stop (distance less than 180 m) to 800 m. During this the bases should be adjustable in the range from 14 to 22 m.

W h e n c h e c k i n g the c o r r e c t f u n c t i o n i n g of the s i g h t proceed as follows :

a) switch on the toggel switches "Accumulator" and "Sight" ;

b) set the arresting lever into the position "Gyro". Within 2-3 second the distincly visible range-finder circle must appear in the field of vision. The time from the moment of switching on to the moment of obtaining a distinct image of the grid depends on the adjusted range and will be smallest when depressing the damping button ;

c) make sure by turning the illumination control that the illumination of the grid changes.

d) make sure by revolving the range control towards oneself (diminish the distance) that the rhombs diverge ; by revolving the range control away from oneself make sure that the rhombs converge. The motion of the rhombs must be smooth without shocks and jerks;

e) make sure by switching the arresting lever to "Nepod" that the ... is visible in the field of vision and the motor does not work. ... arresting should be repeated several times. The position of the ... circle must not change perceptibly (accuracy of arresting ... i.e. approximatelly 2 diameters of the centre point).

f) Switch off the toggle switches "Sight" and "Accumulator". Should the slightest doubts arise about the proper functioning of the sight, it is necessary to turn immediately to the respective specialist of the equipment service.

b) Inspection after the flight

After the flight an inspection should be carried out, which is analogous to that carried out before the flight. In addition to this:

a) switch on the toggle switches "Accumulator" and "Sight" ;

b) after 15 minutes have elapsed (heating-up time of regulator) change the lead by switching the sight from the position "Gyro" to the position "Neped", then switch back to the original position "Gyro". Connect the portable voltmeter with the scale 0-30 V to the socket, connected with the output terminals ("3" and "4") of the voltage regulator. The output voltage must be 22 ± 0,75 V ;

c) if the output voltage is less than 20,4 V or more than 23,6 V the voltage regulator has to be replaced ;

d) if the output voltage is within the margin of 20,4 - 23,6 V, adjust the regulator to a voltage of 22 V ;

e) perform the adjustment by means of the adjusting screw 1 (Fig. 30, 52) ;

f) if the output voltage is less than 22 V, it is necessary to turn the adjusting screw 1 by means of a screw-driver in a clock-wise direction simultaneously noting the voltage on the portable voltmeter;

g) if the output voltage is more than 22 V, turn the adjusting screw 1 by means of a screw-driver in a counter clock-wise direction simultaneously noting the voltage of the portable voltmeter :

N O T E : 1)It is categorically forbidden to switch on the regulator without a load.

2)Ceck the accuracy of the carbon regulator before every flight with the sight switched on. When flying without thr sight being switched on check the accuracy of the carbon regulator periodically every 25 hours of the plane's flight.

3)It is forbidden to dismantle the carbon regulator for the purpose of changing the position of the adjusting screws of the electromagneti and the carbon column.

All observations and defects in the opperation of the sight during the flight and inspection must be reposted immediately by the gunner to the person responsible for the sight.

It is also necessary to check the wear of the automatic electromagnetic limiting device of the angles of deviation of the gyroscope. The check is carried out as follows :

a) set the arresting lever to "Gyro" ;

b) set the base B to 15 -20 m,

c) set the range D = 800 m.

Turn the sighting head in a horizontal direction with an angular velocity of over 7° (see check the wear of the electromagnetic limiting device) the grid must stop at the maximum angle and must not disappear from the field of vision on the intrument. Vibration of the grid is permitted at the extreme position.

4. Contents of ZIP.

ZIP (Fig.55) of the sight consists of the following:

spring belt 1	1 piece
illumination bulbs 2 for 26 V, 12W	4 pieces
semi-transparent mirror 3	1 "
light filter 4	1 "
flannel napkin 5 200 x 200 mm	1 "
silicagel 6 (50 g)	1 tin
protecting cover 7	1 piece
screw-driver 8 for taking off the drier	1 "
tool 9 for exchanging silicagel.	1 "
screw- driver 11 0,8 x 6	1 "
spanner 12 9 x 11	1 "
wire - tool 13 for the gyroscope	1 "

The set ZIP is packed in a wooden case,sealed in the factory. A list of the contents is pasted on the cover. The spare parts 1,2, 3,4 are intended for replacing details worn during operation.

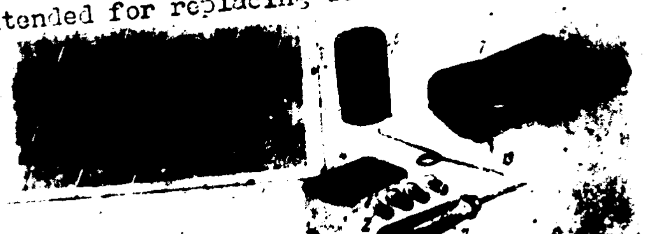


Fig. 55. ZIP of the sigt.

5. RECOMMENDATIONS FOR USE OF ZIP.

Replacing the spring belt

To replace the spring belt :

a) remove the front cover of the sight,as described in the ..agraph "Maintenance jobs";

b) remove excessive grease from the belt ;

c) fit the belt to the belt-pulley of the universal joint and . motor in such a way that the cone,which is at the joint (lock) ..ll run smoothly over the pulleay,i.e. as shown in Fig.56 ;

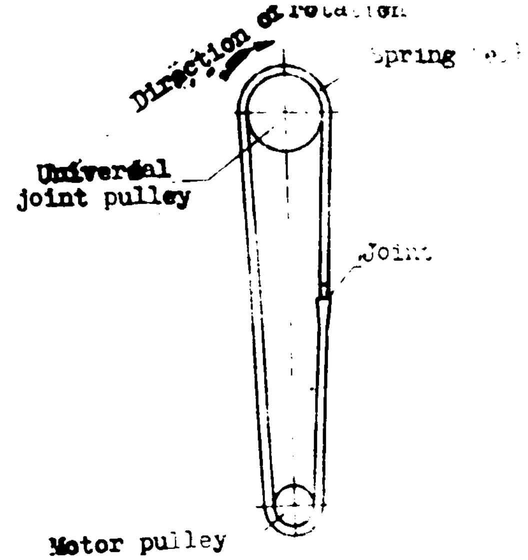


Fig. 56. Diagram of the spring belt drive.

d) in accordance with the above select the position of the belt lock place the front cover with the movable mirror up top and through the hole in the frame place the belt on the mount of the mirror in such . way that it will fit behind it ;

e) with the hook of the wire-tool get hold of the belt from below the relay bracket,pull it up and fit into the motor pulleay. Fit the belt very carefully to prevent it from stratching ;

f) make sure that the belt lies in its groove on the gyroscope ..-pulley.

..lacing the semi-transparent mir-
.. the filter.
..acing the semi-transparrent mirror do not forget to

place the rubber inserts 0,5 mm thick under the clamping strip and the spring washers under the heads of the screws. The screws are screwed tight but not overtight.

Before tightening the screws,pay attention to the fact that the clamping strip does not rest with its bent part from above against the semi-transparent mirror but that it should rest with the whole surface of its projections.

When replacing the filter do not forget to insert 1 mm thick rubber washers in the corresponding hollow under the filter and 0,5 mm rubber washers between the filter and the metal washers.

The way of replacing the bulb need not be explained.

As for maintenance,attention must be paid to the following points:

a) Maintenance of optical details.

The surface of the lens,filter and semi-transparent mirror must always be kept clean. For removing dust and hairs from their surface the flannel napkin 5 (see Fig.55) is used. Impurity and grease must be removed with cotton-wool,soaked in pure spirit,whereupon the glass surfaces must be wiped with a clean napkin.

It is forbidden to touch the surfaces of the optical details with the hands. A cover 7 is used to protect the sight from dust,moisture and the sun (see Fig.55),to be removed only during flight and when checking the sight.

b) Replacement of silicagel.

After having been in use for a certain period of time,silicagel is no longer able to absorb moisture and must be replaced.This can be recognized by a change in the colour of the silicagel which changes from blue to pink.

In order to replace the silicagel more easily,it is recommended first of all to take off the driver 4 from the sight (see Fig.16) together with the attached filter by unscrewing with the another screw-driver 8 the 2 screws,holding it to the sighting head body. This enables us to take off the drier without removing the sighting head.

Replace the silicagel through the observing hole,from which the ... with the glass has been unscrewed by means of a special tool 9 ... 55.

The drying box has two compartments separated by a partition, ... to make sure that all the silicagel has been replaced.

The moisture -absorbing ability of silicagel can be restored. For this purpose sprad it in a thin layer on a metal plate and bake it in an oven at a temperature of 180° C for three hours.

If the temperature of 180° cannot be attained, the time of baking must be extended- Ovens with temperature of less than 100° cannot be used.

If silicagel is dried, it regains its blue colour.

Dehydrated silicagel should be handled with care and not be crushed since pulverized silicagel does not absorb moisture and soils both the filter and the sight.

After drying, the silicagel should be shifted using a sieve wit[h] opening of 0,1x0,1 mm.

Silicagel should be kept in a hermetically sealed container.

. SOME INTRUCTIONS FOR CARRYING OUT MAINTENANCE JOBS

WARNING. When working with the sight, it is necessary to observe the highest possible accuracy and caution.

Lubricating the pivots of the gyroscope universal joint cross-piece.

The necessity of the job is explained by the fact thqt in the course of time, as well as owing to the action of temperature and the accumulation of hard particles (dust, worn off metal) the lubricant Avtol "6" alters its properties (becomes thiek). Thickening and drying out of the lubricant leads to increased friction, which in turn lowers the accuracy of the sight (angles of lead will decrease).

In addition, drying out of the lubricant speeds up wear of the cross - piece pivots.

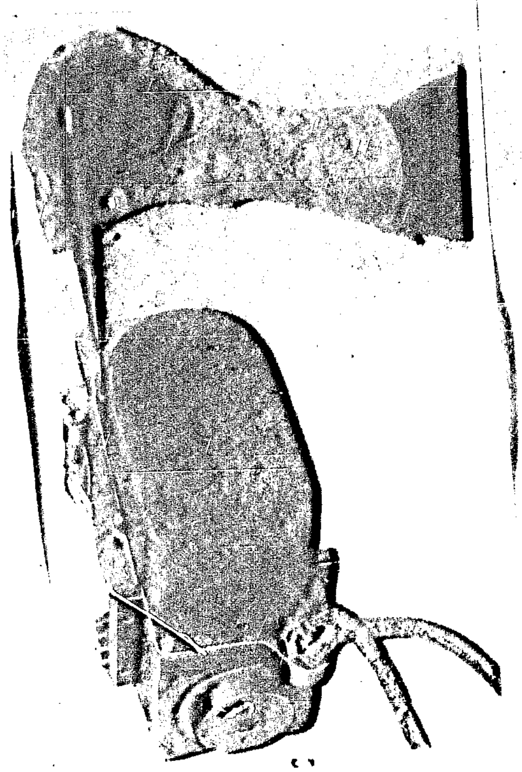
In order to carry out the given job, it is necessary to prepare;

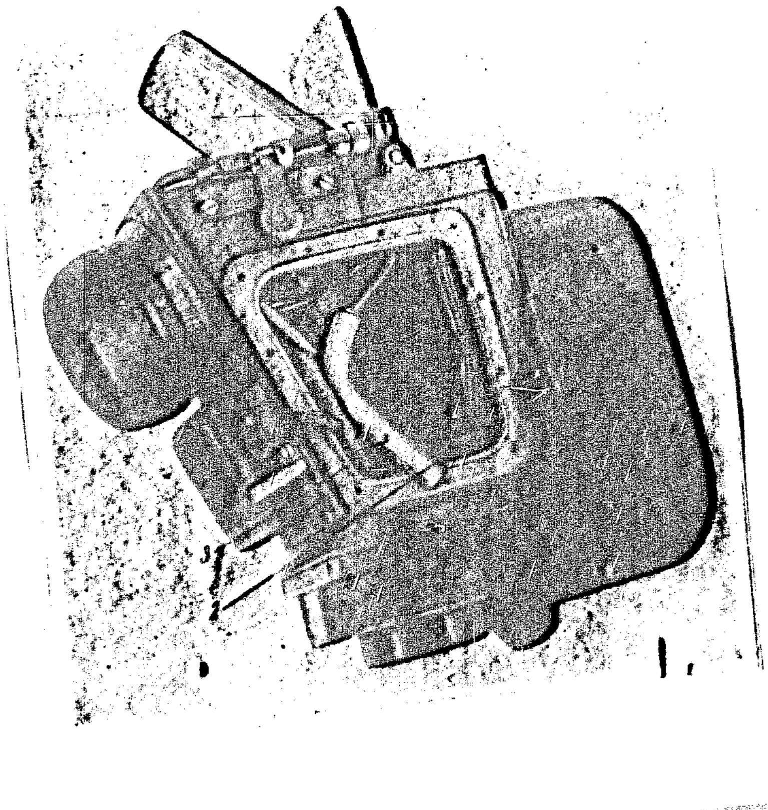
1) an accumulator with a voltage of 27 V ± 10%, with leads ;
2) a bottle of the lubricant Avtol "6", of a standard 1862-42 ;
3) a screw-driver ;
4) two wire tools for the gyroscope (from the individual ZIP of the sight);
5) nitrolacquer (or enamelit) ;

The job is performed in the following order :

1. Stand the sighting head properly on the rear cover (Fig.57) After unscrewing 4 screws take off the casing. Put the screws ... casing.

Fig.57 - 58 ......page 38





2) Stand the head with the side cover up and after unscrewing the screws take off the side cover. Put the screws into the casing. Remove the rubber tube 3 (Fig.58) from the end of the coil.

3) Stand the head again on the back cover and unscrew the remaining 2 centre screws which join the front cover to the body. Place the arresting lever precisely into the centre position and maintaining it in that position with one hand, carefully separate with the front cover from the body. Remeber that the front cover may be dowel pinned with two dowel pins and that it will therefore be hard to remove.

4. Depress the motor contacts with the spring ring of the gyroscope wire tool to prevent the arresting frame from hindering.

5) Take the front cover with your left hand by the motor, with the gyroscope mirror turned away from yourself. Hold it somewhat downward the larger side of the cover being placed horizontally. With the ring-finder of your left hand tilt the gyroscope mirror slightly. Turn the motor belt-pulley so as to be able to see through one of the two openings in the gyroscope body the place where the conical pivot of the short axis of the cross-piece sits in its bearing. Dip the bent end of the second wire tool into the lubricant Avtol "6" and picking up a drop of oil insert the end of the hook into the space between the conical pivot and the bearing.

Examine with attention the space between the conical pivot of the cross-piece and the bearing and make sure that it contains the lubricant.

6) Turn the motor belt-pulley through 180° and tilt up the opposed end of the univers al joint. Lubricate the other end of the cross-piece in the space between the conical pivot and the bearing.

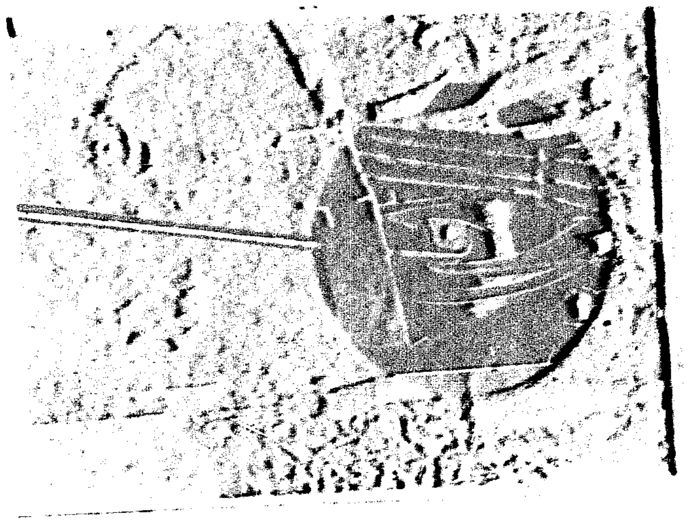
7) Turn the belt-pulley through 90°. Insert the hook, which has been previously dipped into Avtol "6" into a small (millimeter sized) hole in the gyroscope body (the aluminium part, onto which the mount of the gyroscope mirror is screwed (Fig.61 and 62).

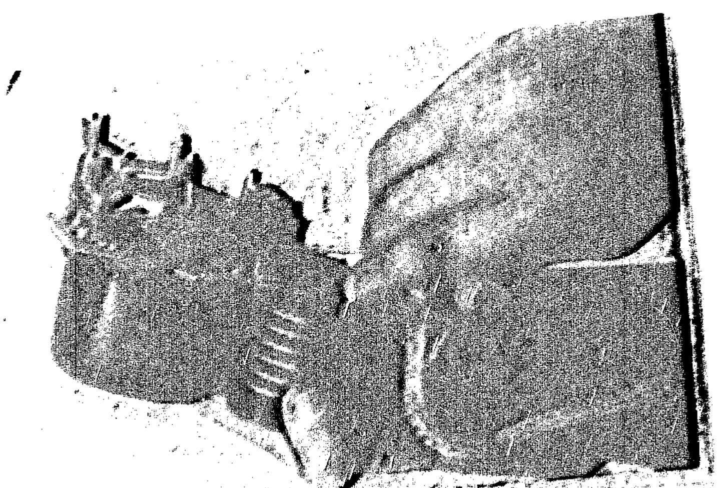
8) Turn the belt-pulley through 180° and repeat the procedure.

9) Lubricate the four pivots as bb (Fig.63) twice as described under 5,6, 7 and 8.

10) Switch on the gyroscope motor and connect the negative pole of the accumulator to pin No 10 and the positive pole to pin No 9 of the connector marked "Sighting Head" (the motor contact must be closed).

Fig. 59-60 ......page 90
Fig. 61-62 ...." 91





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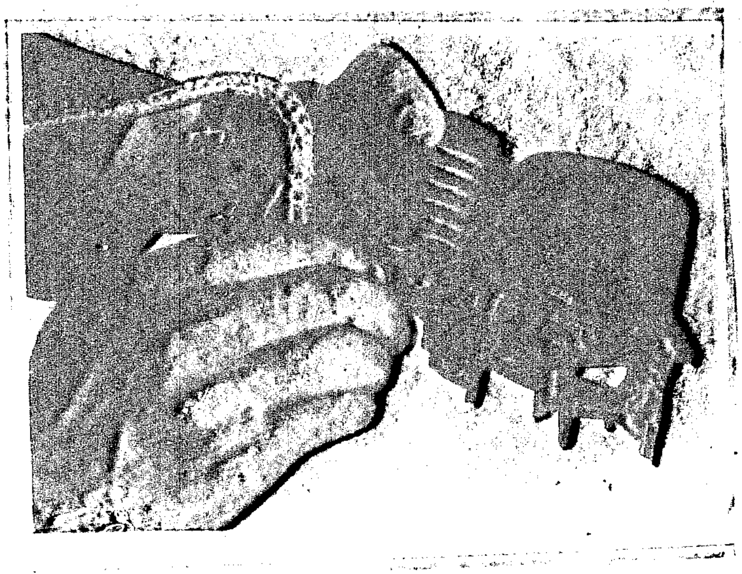

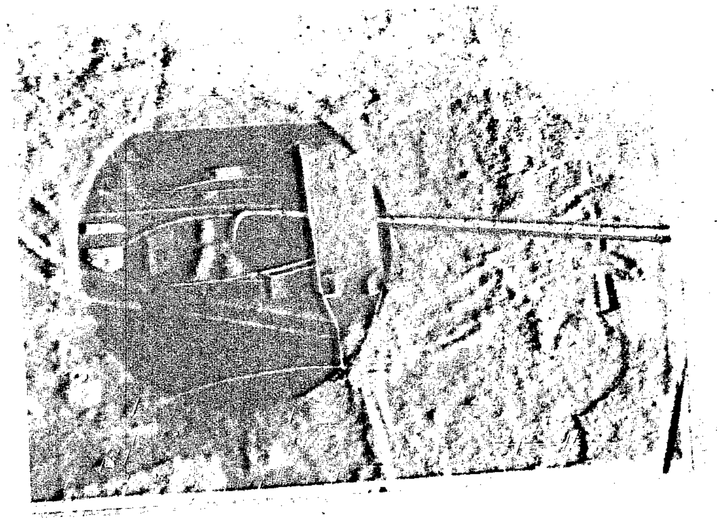

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Let the gyroscope rotate for several minutes to permit the oil to be foeced under the action of the centrifugal force into the bearing.

Fig. 63.

11) Take the front cover into your right hand. Remove the lamp from the motor contacts and keeping the arresting lever in the centre position between "Gyro" and "Nepod", place the front cover exactly into the body. Make sure that the pin on the arresting fork entered the slot in the fork of the arresting lever. Do not forget that the cover is to be placed down on the dowel pins, that the assembly wires must not be moved or touch the body, and the rubber band pasted into groove of the body must not be damaged.

Turn the arresting lever into the position "Nepod" and "Gyro" and make sure, that the arresting mechanism works properly. Screw on the casing on the front cover. Fit the rubber tube to the end of the coil. Screw on the side cover (seeling the screws with nitrolaquer or enamelit).

12) Replace the sight into the aircraft. By means of the device P-3P check the revolving time of the free gyroscope. If it does not ... seconds, repeat the lubrication. If the repeated lubrication ... help, the sight has to be repaired on a testing stand.

13) The sight has to be repaired if,when tested on the testing stand it is fouhd that the angles of lead are not within the tolerance.

Cleaning the collector and blowing out the motor ЖG-2

The becessity of the job referred to is explained by the fact that the operation of the motor inevitably results in the formation of a carbon film on the collector and on the brushes,as well as the production of brush dust due to the abrasion of the brushes.

The contact of the brush surfaces and the collector is not ideal and that is why sparking takes place,causing the formation of the carbon film. This film is detrimental to the operating qualities of the motor. The brush dust on the other hand can form "bridges" and is one of the causes of a lowering of the insulation resistance and even of short-circuits. Apart from this,it can reach the bearings and may worsen the functioning of these.

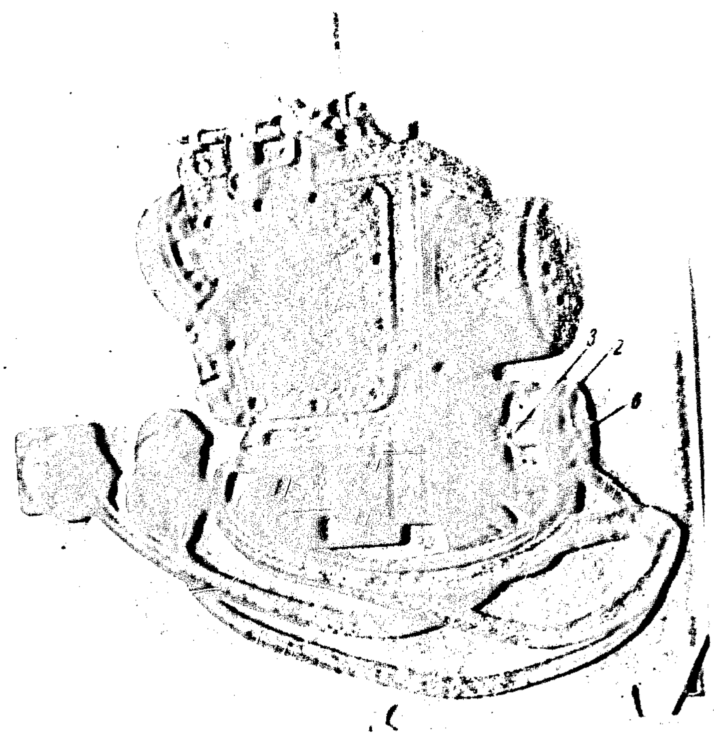
In order to carry out the given job,it is necessary to prepare:

1) an accumulator having a voltage of 27 V ± 10% with leads ;
2) a container of compressed air (with a pressure of 2-4 atm.) with a hose ;
3) a screw-driver 6x 0,8 and spanner 9x11 from the sight's ZIP ;
4) fine emery paper M-14 or M-20 with a grain of 600-500,otherwise, spirit and a clean cloth ;
5) nitrolaquer or enamelite.

The job should be performed in the following order :

1) stand the sighting head exactly on the rear cover ;
2) un-screw the four screws and take off the casing from the front cover of the sighting head (see Fig. 57).Put screwes and spring washers into the casing :
3) un-screw the union nut of the coil with a spanner.Remove the coil;
4) un-screw the four screws that tighten the motor casing (screws are sealed with black enamel) and take off the causing (Fig.64). Put the screws into the casing.
5) Switch on the engine,connecting for this purpose the negative pole from the accumulator to pin No 10 and the positive pin to No 9 of the connector marked "Sighting head". Switch the lever of the sighting head from "Nepod" to "Gyro ";
... the carbon film neatly from the collector through the ... front and shield 1 (see Fig.66) by means of anarrow

Fig. 64-65.......page 94



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strip of fine emery paper, folded several times ;

7) switch off motor ;

8) un-screw the screw 2 (Fig.65) fastening the cover of the brush-holder 3. Take off the cover ;

9) mark the brush-holder 4 and the sleeve 5 (Fig. 66) with the end of the screw driver so that during reassembly the brush can be replaced in the original position :

10) cautiously take out the brush-holder with the brush ;

11) do the same with the other brush-holder and brush ;

12) blow out the engine with compressed air through the sleeve, the brush-holders and the window in the front end shield ;

13) examine the brushes. Remove the carbon film cautiously by means of fine emery paper or ordinary clean paper ;

14) reassemble in reverse order. Be careful to replace the brushes into their respective places and in the original position.

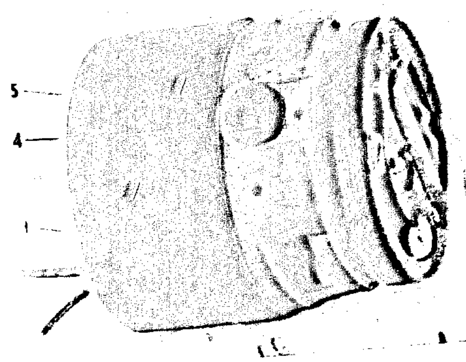


Fig. 66.

Before closing the motor casing it is recommended to switch on the motor and make sure that it works. The screws of the motor must be sealed with nitrolaquer, enamel or enamelite. After having finished switch the arresting lever to "Nepol".

WARNING : It is categorically forbidden to use emery paper with a grain of lessthan 500, as it results in scratches and abrassions being produced on the collector and damping the motor. If fine emery is not at hand, it is possible to remove the carbon film from the collector brushes by means of clean cloth, soaked in spirit and fastened to a small piece of wood.

In this case do not switch on the motor but rotate the collector [illegible], cautiously taking hold of the regulator 6 (Fig. 65).

7. GENERAL INSTRUCTIONS FOR USING THE SIGHT.

The method and practice of using the sight are dealt with in special instructions and directions.

Only some fundamental positions are explained below which must be born in mind when using the sight and wh ch follow from its constructional peculiarities.

a) Position of the gunner's eye

The dist ance of the gunner's eye-pupil from the semi transparent mirror along its optical axis must not be more than 250 mm. If this distance is increased to over 250 mm, the image begins to fade out of the field of vision. When producing an angle of lead (e.g.upwards) the gunner must move his head into the opposite position (i.e.downwards, which is inconvenient in practice,or approach the sight so as to see the whole grid.which is more convenient in practice. The conditions of the grid's visibility are shown in Fig. 67.

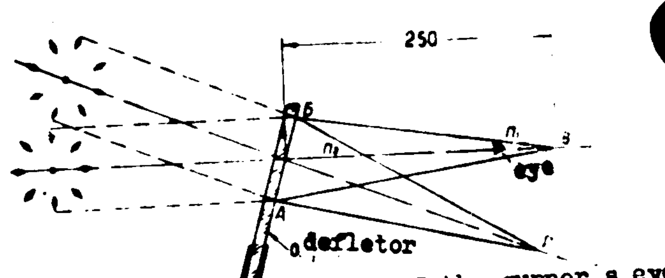


Fig. 67. Movement of the grid and position of the gunner's eye semi-transparent mirror.

The cone ABV is obtained when forming an image of the grid. It forms a zone,where beams pass from all points of the grid,i.e. in this zone the whole grid is visible to the eye. In order to see the deflected grid,the gunner must move his eye from position P_1 to position P_{2+} or move his head aside (downward) in order that his eye may come into position D (G).

b) Instruction for sighting.

The necessary c nditions of sighting,which ensure the correct angle of lead of the sight,are as follows :

1) A correctly adjusted base of the target.

If the base is not adjusted correctly,even when framing the target ...ly, a false distance will be introduced into the sight.

Consequently, even when inscribing the target correctly, the angle of lead produced, will not be correct.

It is always necessary to take for a base the real span of the target and to establish it on the scale of bases, independently of the visible foreshortening of the target. In case of land targets an outline dimension is to be assumed as a base.

The base can be established both on land before take-off and in the air, immediatelly before the attack.

In the range-finder mechanism, the average fore shortening of the target 1/4 lying between the most probable foreshortenings 2/4 and 0/4 is taken into account, so that no corrections for the foreshortening have to be made.

2) The correct establishment of the plane's own velocity.

Incorrect introduction of the plane's own velocity at the moment of sighting causes errore in the lag corrections of the sight.

3) The correct establishement of the plane's own altitude of flight.

Incorrect introduction of the altitude of flight at the moment of sighting causes errors in the angles of lead and lag corrections formed by the sight.

4) Accurate and continuous framing of the target into the variable diameter circle.

Accurate and continuous framing of the target is necessary as during the attack the range varies continually (usually decreases). Incorrect untimely adjustment of the range results in the production a false angle of lead by the sight.

5) An adequate sighting time.

The time of sighting, sufficient to a first approximation, equals 1 - 2 sec.

c) Purpose of switching to " NEPOD".

As a rule fire is opened using the movable grid, i.e. with the arresting lever set to "Gyro".

The position "Nepod" is intended for use in those cases, when the angle lead is more than 8°, sighting is practically impossible, the grid is continuously "breaking up" (due to the mirror mount striking against the mechanical stops).

In this case, the sight has to be switched to position "Nepod" and the constant diameter circle of the stationary grid, opened fire, while noting the foreshortening and velocity of the target. In this case the instructions and rules for sighting with ordinary collimator sights (e.g. NKI) have to be adhered to.

It is necessary to remember that the angular diameter of the constant diameter circle (stationary grid) equals 132 thousandths, and is counted :

in the first place for v_t = 100 m/sec; D = 400 m ; foreshortening 2/4 ;

in the second place for use of the stationary grid in cases when the electrogyroscopic part of the sight gets out of order.

d) Purpose of the damping button.

During an aerial fight the gunner, who is carrying out sighted fire on the attacking fighter, is obliged, in order to follow the target, to throw over with great angular velocity the gun and together with it the sight from one side to the other. During such sudden turns of the sight, the mount of the gyroscope mirror strikes against the mechanical stops causing disappearance of the centre point and the range-finder circle due to blurring.

In order to avoid shocks of the gyroscope's mirror against the stops, a resistor R=20 Ohms is included in the circuit of the sight, which shunts the range rheostat of the angles of lead ; this resistance is connected by means of the damping button. Switching in this resistor greatly increases the current in the gyroscope winding, owing to which the deviation of the gyroscope becomes very small at that moment.

e) Use of the lamp rheostat and of the light filter.

Depending on the value of illumination of the background, in which the target moves, the brightness of the grid must be selected by means of the illumination control in such a way that the grid may be distinctly visible, not, however, blinding the gunner's eye. It is clear that at night the brightness of the grid will be smallest, while for a background of brightly illuminated clouds or in the direction of the sun it must be maximum. In the latter case, the rheostat is completely short-circuited (the illumination control is set to the stop), the grid's brightness may however, still be insufficient. In this case the light filter has to be used by raising it to the elevated position.

f) Use of the mechanical sight.

The mechanical sight consists of the usual ring sight with fixed base. Its data correspond to the outer constant diameter circle of the stationary grid. The establishment of the angles of lead and sighting is performed in the usual way, according to the foreshortening and the velocity of the target.

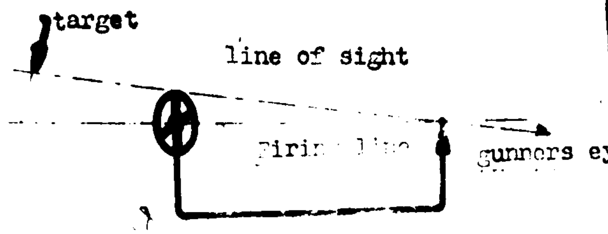


Fig. 68. Sighting with the mechanical sight.

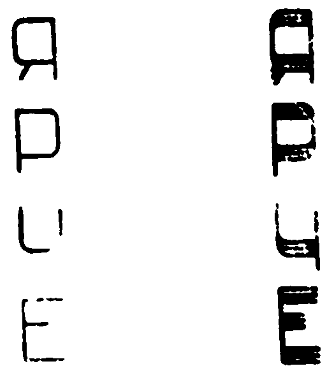
The mechanical sight is used in those circumstances, when it is impossible use the movable or stationary grid, e.g. if the illumination bulb or the fuse have burnt out and it is not possible to replace them during flight, if the grid, when switched to "Nepod" is not arrested or visible at all etc. (Fig.68).

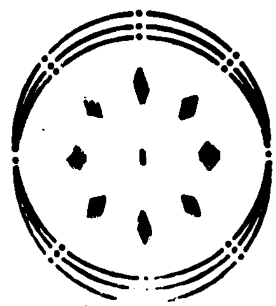
g) Vibration and blurring of the grid.

An indistinct or blurred image of the movable grid is a symptom of a defect (the gyroscope is unbalanced) or of vibration. In the latter case the blurring of the grid during the flight (both movable and immovable grid) may be due to a loose and vibrating semi-transparent mirror can easily be detected (place your hand on the deflector and stop its vibration, the image of the grid becomes distinct.)

Considerable vibration of the whole sight and as a consequence of the grid can be discovered by observing the inscription "JARČE" ("more brightly") on the lamp holder cover (Fig.69 shows on the left the appearance of this inscription if the vibration is insignificant, on the right if the vibration of the sight is considerable. The blurring of the inscription takes place in the direction of the vibration. In addition, the grid becomes considerably blurred by the recoil of the gun, during firing, especially if the sight is switched to "Nepod".

The blurring of the grid, discovered during the flight, cabnot serve as a cause for interrupting the flight. Even for considerable blurring the grid the possibility of sufficiently accurate sighting is en- . The nature of the image of the blurred grid during vibration is Fig. 25.





Figures - 69 - 70.

The blurring of the grid, discovered during the flight,cannot serve as a cause for interrupting the flight, Even for considerable blurring of the grid the possibility of sufficiently accurate sighting is ensured. The nature of the image of the blurred grid during vibration is shown in Fig. 85.

h) Change of diameter of the variable circle.

The diameter of the variable diameter circle,formed by the inner ends of rhombs,can vary from 17,5 thousandts to 122 th.,almost reaching the diameter of the constant diameter circle, which is equal to 132 thousandths (Fig. 71).

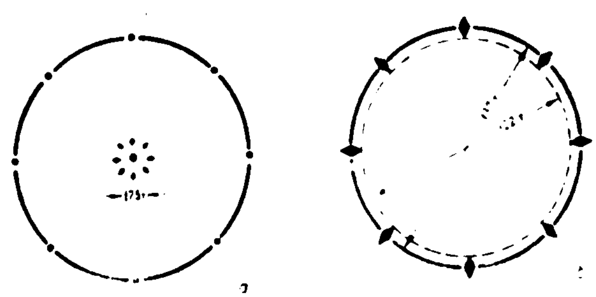


Fig. 71. Diameters of the variable diameter circle.

If the base is set to less than 14 m,the rhombs will converge,when altering the distance within the possible limits,to the smallest possible diameter (Fig. 71a),but will differ from the largest diameter ... shown on Fig. 86b,by a certain value. If the base is set to ... 22 m, the rhombs will diverge to the largest diameter (Fig.

but on convering will differ from the smallest diameter,sown on Fig. 71 a,by a certain value. In the range of bases from 14 to 22 mm the diameter of the variable diameter circle varies,reaching neither the largest not the smallest value,even though the distance introduced into the sight is varied over the whole range from the 18⁰ to 800 m.

8. TRANSPORT AND STORING OF THE SIGHT.

a) Transporting the sight.

1) The sight must be transported in its packing case only.

2) When transporting pack the packing case in a transport case with wood shavings interposed between the case sides or put a shock absorbing mat under the packing-case.

3) The packing case must be placed handles up during transport.

4) It is categorically forbidden to throw or turn over the cases.

5) Before packing the sight in the case set the arresting lever on the sighting head to "Nepod" and make sure of the correct position of the case and of the shock-absorbing springs.

6) Pack the sight equipment in strict accordance with the packing instuctions,placed on the cover of the case.

b) Storing the sight

The sight requires good storing conditions. The most dangerous factor for the sight is high moisture (humidity) content. To avoid the possibility of mechanical damages, independently of the period of storing keep every sight with its equipment in a packing case.

The cases with the sights have to be kept on shelves in stores with the smallest possible humidity and without ectreme fluctuations of temperature.

Before packing the sights for storing make sure that nothing is missing that

1) there are no breakages or damaged details of the sight (light filter,semi-transparent mirror,doubler,connectors protecting,cover etc.)

2) The moving parts (dials,drums controls are free to move in a normal manner);

3) the silicagel has a blue colour; if it is pink (silicagel is saturated with moisture),replace it with dehydrated (blue);

4) the waterproof coating is not damaged, in case of its being

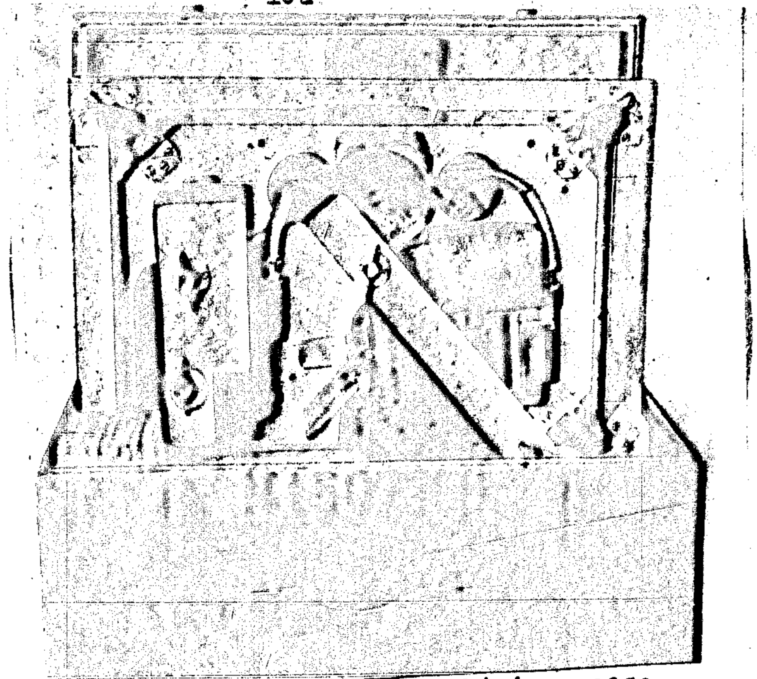


Fig. 72. Packing of a sight in a case.

damaged recoat the damaged place with a waterproof putty by means of a soldering iron.

The arresting lever must be set to "Nepod".

Check the state of silicagel not less than once in a fortnight and, if necessary, replace it.

Before installing the sight:

1) check that nothing is missing
2) wipe the lens, deflector, light filter neatly with a clean flannel
3) make sure by an outside inspection that no damages have occured;
4) check the free motion of the drum, dials and controls ;
5) check the state of the silicagel ;
6) connect to a source of direct current with a voltage of 27 V ± 10% switch on and with the arresting lever set to "Nepod" and "Gyro" make sure that the lamp is lit and that the motor turns with the lever set to "Gyro".

[illegible]lt	Causes	Determination of causes	Elimination of fault.
[illegible] to "Gyro" the [illegible] does not work, the [illegible] does not revolve, illumination bulb [illegible] not light up.	a) A burnt fuse b) Break in the electrical circuit to the junction box or inside it c) False connection of the sighting head rheostat, altitude connector and range speed mechanism	a) Check the fuse b) Check the voltage in the junction box in the section "Deck supply terminals" (1 and 2), established the source of damage using circuit diagram c) Check inscriptions	a) Replace the fuse b) Eliminate fault found c) Reconnect connectors
The motor does not work with the arresting mechanism lever being set to "Gyro". The illumination bulb is alight.	a) Interrupted supply to the motor b) Damaged contacts on the arresting mechanism c) Damaged motor	a) Check voltage across motor circuit in female connector "Sighting head" (pins 9 and 10). b) Check the motor circuit in the sighting head (pins 9 and 10 of the female connector "Sighting head") Take off cover and check motor contacts. c) Check the motor circuit at the contacts of the arresting mechanism	a) Eliminate fault found in the circuit with voltage switched off b) With the voltage switched off, remove the sighting head cover and bend contacts c) Clean the collector or replace the motor.
The image of the grid is not visible when switching to "Nepod".	a) A burnt out illumination bulb b) Interrupted lamp circuit c) No contact in the lamp holder d) Burnt rheostat	a) Check by outside inspection b) Check whether there is voltage between the lamp holder abd the right terminal of the illumination rheostat. c) There is a voltage in the terminals, the bulb is in order d) There is no voltage on the left terminal of the rheostat and lamp holder.	a) Replace lamp b) Check with the voltage switched off and repair electric circuit c) Repair contact d) Replace rheostat (in repair shop)

Fault	Causes	Determination of causes	Elimination of fault
...f the grid is not ...ible, when the level on "Gyro" or the image ... considerably shifted.	Broken spring belt	Switch over to "Nepod" and make sure, that the circles are visible in the field of vision	Replace belt, fit with strenchened part of the lock in direction of rotation the motor
Blurring of the image of the grid with voltage of supply not less than 23,4 V	a) Low output voltage from the regulator b) Gyroscope out of balance c) Loose semi-transparent mirror (observed with wibration on)	a) Measure with a voltmeter the voltage on terminals "3" and "4" of the voltage regulator b) Observe the movable grid with the sight in motion c) Observe the movable and stationary grid with the sight working or by checking the deflector	a) Regulate output voltage of regulator to 22+0,75V b) Balance or replace gyroscope in repair shop c) Tighten 2 screws, holding semi-transparent mirror
When turning the range control, the range drum does not revolve and the rhombs do not move.	Loosened drive cable (slipping)	Make sure whether the cable slips on the belt-pulley when pulled on	Tighten screw of the cable on the belt-pulley
Loosened fixing screws in the sight	Loosened due to the vibration	Screw on with a screw-driver	Tighten screw, seal with nitro-laquer
Semi-transparent mirror broken	Outside damage	Inspect	Replace and check the ranging
Light filter broken	Outside damage	Inspect	Replace
The range drum revolves with difficulty	a) Incorrect adjustment of cable driver b) Excessive friction of belt pulley on the shaft	a) Check with the cable detached b) Check without sighting head	a) Adjust cable b) Unscrew and grind in shaft with belt-pulley

Fault	Causes	Determination of causes	Elimination of fault
	c) Damage drive of range drum	c) Check on demounted sighting head	c) Change the drive of rang drum
Time free of precission of gyroscope from 3 to 1° less than 8 sec.	a) Changed quality of lubricant in universal joint b) wear of universal joint	a) Measure with the device P-2P and a stop-watch	a) Carry out the job according to the instructions on lubricating pivots of gyroscope universal joint b) Replace gyroscope or universal joint (in a repair shop).
When switching on sight operation of radio-system sharply deteriorates	Faulty radio interference suppressor	Switch on and off with sight on "Gyro" operating and radio equipment	Replace radio interference suppressor
When pressing on the damping button, the gyroscope strikes against the limiting stops	Interrupted circuit of damping button	Check damping button circuit using wiring diagram	Eliminate fault found in circuit
Angles of sight are not formed	Interrupted circuit of angles of sight	Check sighting angle circuit using wiring diagram	- " -
Angles of lag are not formed	Interrupted circuits of angles of lag	Check angles of lag circuit using wiring diagram	- " -
During sudden turns of sight image of grid is blurred(electromagnetic stope of gyroscope angles of turn do not function)	a) Relay RP-7 faulty b) Bad contact between junction box body or body of sight and body of plane	With the voltage switched on in the sight a) When shortening wire 58 in junction box, relay should clock characterizing proper functioning of relay RP-7.	a) Replace relay RP-7 with a good one.

Fault	Causes	Determination of causes	Elimination of fault
		b) Test with Ohmmeter between body of junction box, body of sight and body of the plane. In a good circuit short circuit must occur.	b) Eliminate fault by repairing contact between the junction box body and sight body (body of plane) by cleaning the contact surfaces.)
	c) Burnt shunt resistor r_2 = 55 Ohms	c) Test with an Ohmmeter between terminal 10 of the junction-box terminal and of the relay. The resistance must be 55 Ohms if circuit is in order	c) Replace resistor r_2 = 550 Ohms
	d) Bent filament stop of the electromagnetic stop lubricant got on to contact and the circular collar broken or unsoldered lead in circuit of electromagnetic limiting device	b) Connect wire 58 in the junction box to the junction box body, where the electromagnetic limiting device must work in analogy to the work with the damping button switched on.	b) By bending the filament adjust correct contact with a circular collar wipe contact surfaces of collar and filament with cotton-wool, soaked with in spirit and let spirit evaporate, remove the break on resolder wire in electromagnetic limiting circuit.

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VI. DESCRIPTION OF THE SIGHT ASP-3P WITH AN ELECTROMAGNETIC LIMITING DEVICE FOR THE ANGLES OF DEVIATION OF THE GYROSCOPE.

As a result of a improvement the sights ASP-3P are now produced with an electromagnetic limiting device of the angles of deviation of the gyroscope.

The use of the electromagnetic limiting device enables, the gunner to follow the target with large angular speeds of the turret IL-K6. The movable grid does not disappear from the gunner's field of vision, as the gyroscope is "braked" when at its maximum deviation (about 8°).

Sights with an electromagnetic limiting device do not differ constructionally and in principle from the sight produced before, except for the individual units.

Below, a description is given of those units which are not part of the equipment of the previous type of sight, as well as of those units, differing in their mechanism.

Complete Sight.

The complete sight (Fig. 73) consists of the following units :

1. Sighting head with the range rheostat.
2. Computing mechanism.
3. Speed mechanism.
4. Altitude mechanism.
5. Junction box.
6. Voltage regulator.
7. Electromagnetic limiting device.
8. Radio interference suppressor.

A new unit in the equipment is an electromagnetic limiting device.

ARRANGEMENT AND PRINCIPLE of operation of the electromagnetic limiting device for the angles of deviation of the gyroscope.

Contrary to the damping of the gyroscope with a special button, the electromagnetic limiting device performs the braking of the gyroscope axis automatically for deviations exceeding 7° 50.

The electromagnetic limiting device consists of the box, contact arrangement placed on the gyroscop and the circuit diagram.

Fig. 73. Complete sight with the electromagnetic limiting device 1-sighting head with the range rheostat ;
2-computing mechanism ;
3-speed mechanism ;
4-altitude mechanism ;
5-junction box ;
6-voltage regulator ;
7-electromagnetic limiting device.

B O X of the electromagnetic limiting device.

The box of the electromagnetic limiting device 7 (see Fig. 73) consists of a body made of an aluminum alloy, which has mounted inside a polarised relay RP-7, a condenser having a capacity of 2 uF and a series resistor of 55 Ohms on a coil, connected in the contact circuit of the relay.

The box of the electromagnetic limiting device is connected to the junction box by means of a transition socket with a threecore cable and a three-pin connector.

C o n t a c t a r r a n g e m e n t (Fig.74.

The shunting of the range rheostat during the deviation of the gyroscope exceeding maximum angles is obtained by a contact arrangement switching on the relay RP-7.

The contact arrangement is located in the gyroscopic assembly. Two contacts made of hard bronz in the shape of filaments are attached to the bottom of the mirror mount.

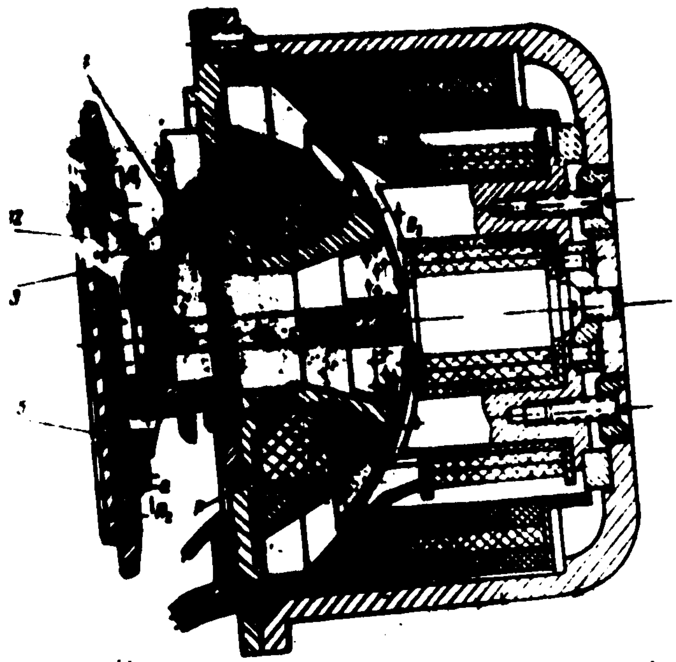

Fig. 74. Contact arrangement of the electromagnetic limiting devic

The cover of the gyroscope assembly carries a circular collar 3 attached to the insulating bracket 4.

This collar and filaments form contacts switching the winding of the polarised relay RP-7. One of the filaments is bent towards the body 5 and is a spare, the other 12 is adjusted so as to touch the collar for the gyroscope deviating through an angle corresponding to the deviation of the line of sight in the field of vision exceeding $7^{o}50$.

CIRCUIT DIAGRAM of the electromagnetic limiting device.

The circuit diagram of the electromagnetic limiting device (see Fig. 75) consists of a polarised relay RP-7 (P_2), the coil of which is connected to the positive pole of the stabilized voltage (wire1) and to the contacts KN e.r. Parallel to the coil a condenser C is filled. The shunt resistor R_2 shunts the range rheostat R_{o3} of the load circuit and shunt circuit of the altitude mechanism.

The circuit with the resistance R_2 is closed in the following way. For large angular speeds of the sight, while following the target, the axis of the gyroscope tends to turn through an angle surpassing the limiting angle. When the mirror mount gets near the mechanical stop the filament 12 (see Fig. 74) fixed to the bottom of the mirror mount, touches the collar 3 and closes the circuit of the relay winding RP-7. The relay operates and closes the circuit with a resistor r_2 . As a result of this the maximum current passes through the lead coil of the gyroscope, and a strong magnetic field is produced, which holds the gyroscope cup and prevents the blurring of the image of the grid.

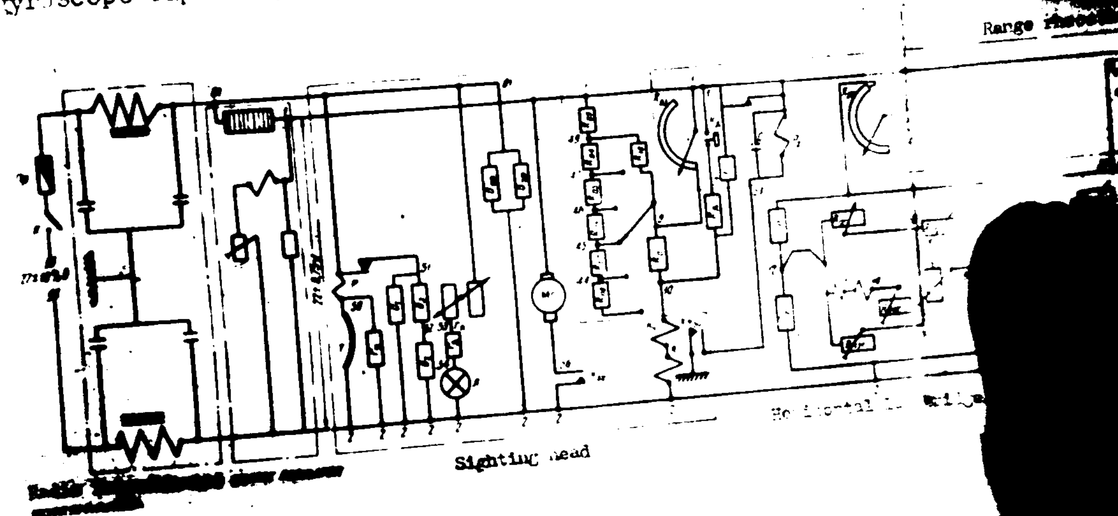

Fig. 75. Main circuit diagram of the sight with the electromagnetic limiting device.

r_4 - series resistor of the illumination rheostat (r = 6.5 - 70 Ohms) T - thermoregulator ($t_{sw.}$ out 47 ± 5° C, I_1 - supplementary heater (r = 25 Ohms), O_2, O_3 - supplementary heater (r = 25 Ohms), r_2 - spark suppressing resistor (r = 5100 Ohms) ; P - heater relay (w = 5500 turns, r = 610 Ohms) , r_{il} - illumination rheostat (r_{il} max = 170^{+30} Ohms, r_{il} min=1,5 ± 0,5 (L-lamp) 22 V,12 W, Mg - gyroscope motor DG-4-sb, K_{ar} - arresting c tact, O_n - electric heater of the mirror (r = 375 Ohms), O_h - elect heater of the lens (r = 200^{+20} Ohms), k_d - damping button, R_{04} R_{09} - altitude shunts of the range rheostat, R_{10} - shunted altit resistor, R_{01} series resistor in lead circuit, R_d - damping circuit resistor (r = 20 Ohms) , c - coil of lead (w = 1020) ; r = 18,7 ± 0,8 R_3, R_{3h}, R_{3v}, R_{3p} - range rheostat, c_h - horizontal lag coil (w=3000 r = 144 ± 5 Ohms); C_c - vertical lag coil (w=3440; r = 128 ± 5 Ohms), xis of the gyroscope tends to turn through an angle surpassing the limiting angle. When the mirror mount gets near the mechanical stop the filament 12 (see Fig. 74) fixed to the bottom of the mirror mount, touches the collar 3 and closes the circuit of the relay winding RP-7.

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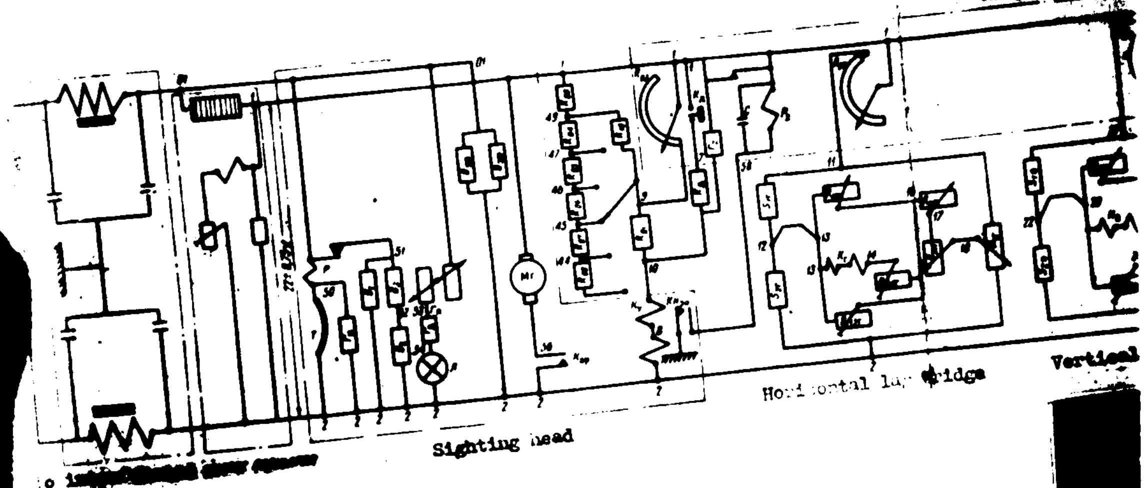

Fig. 75. Main circuit diagram of the sight with the electromagnetic limiting device.

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irror mount gets near the mechanical stop
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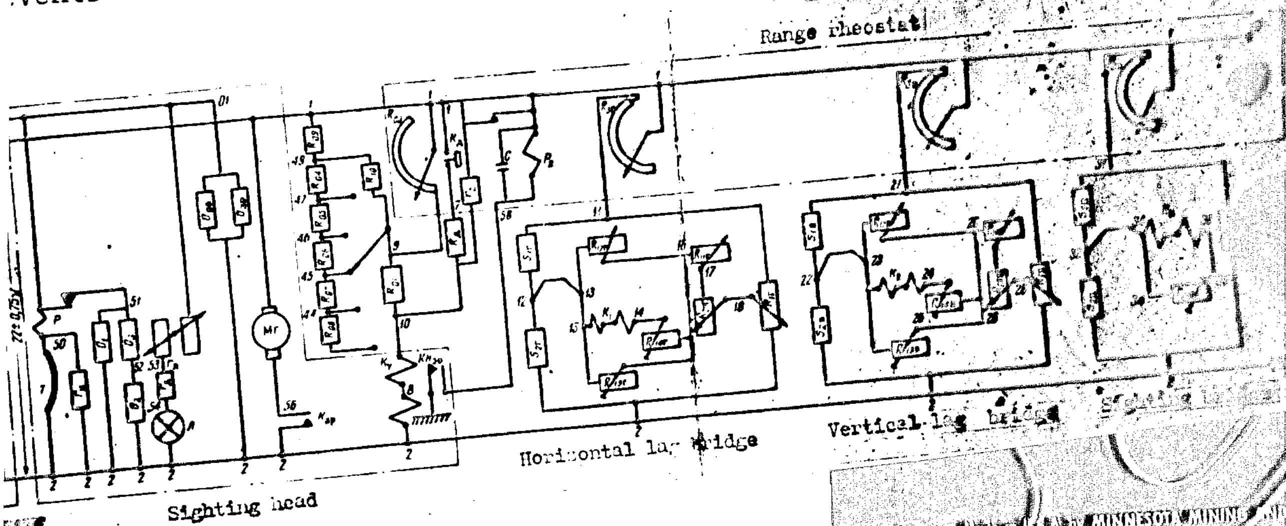

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agnetic limiting device.
of the illumination rheostat ($r = 6.5 - 70$ Ohms),
($t_{sw.}$ out $47 \pm 5^{\circ}$ C, I_1 - supplementary heater
3 - supplementary heater ($r = 25$ Ohms),
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= 5500 turns, $r = 610$ Ohms) ,
heostat (r_{i1} max $= 170^{+30}$ Ohms, r_{i1} min$=1,5 \pm 0,3$),
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sistor in lead circuit, R_d - damping circuit
- coil of lead ($w = 1020$) ; $r = 18,7 \pm 0,8$ O
rheostat, c_h - horizontal lag coil (w=3800
lag coil (w=3440; $r = 128 \pm 5$ Ohms),

r_2 - fixed resistor (r = 55 Ohms), P_2 - pol[illegible]
C - condenser 2 uF ; KH_0 lin - contact of ele[illegible]
device, $S_{1\,h}$, $S_{2\,h}$, $S_{1\,v}$, $S_{2\,v}$, $S_{1\,s}$, $S_{2\,s}$ - fixed resi[illegible]
100 ± 0,5 Ohms) , $R_{12\,h}$, $R_{12\,v}$ - PD 400 (kl.3) and $R_{11\,h}$ $R_{11\,v}$ -
PD 160 (kl.3) variable resistors of the mechanism 4 (speed),
$R_{1\,h}$, $R_{1\,v}$, $R_{1\,p}$ - PD160 - potentiometers for introducing angular
parametrs of the mechanism 3 (computing),
$R_{14\,h}$, $R_{14\,v}$ - JUS-50 ; $R_{13\,h}$, $R_{13\,v}$ - JUS-1000 ; $R_{20\,h}$, $R_{20\,v}$ -
PDR 500 - variable resistors of the mechanism 6 (altitude),
C_s - sighting coil w = 400, r = 20 ± 4,0 / - JUS-50.

N O T E : For sudden changes of position of the turret; in cases if forced operation,it is still necessary to use the damping button otherwise, the electromagnetic limiting device may be damaged due to braking or bending of the filament 12, fixed to the bottom of the gyroscope mirror.

The main circuit diagram of the sight.

Unlike the main diagram on Fig.11 the circuit diagram in Fig. 75 includes the electrical circuit of the electromagnetic limiting device,dealt with above.

For a thorough acquaintaince with the circuit diagram of the sight its description, given on page 110 point 3) must be consulted.

The wiring diagram and the diagram of installation is shown in Fig. 76 and 78.

Fig. 76......page 112

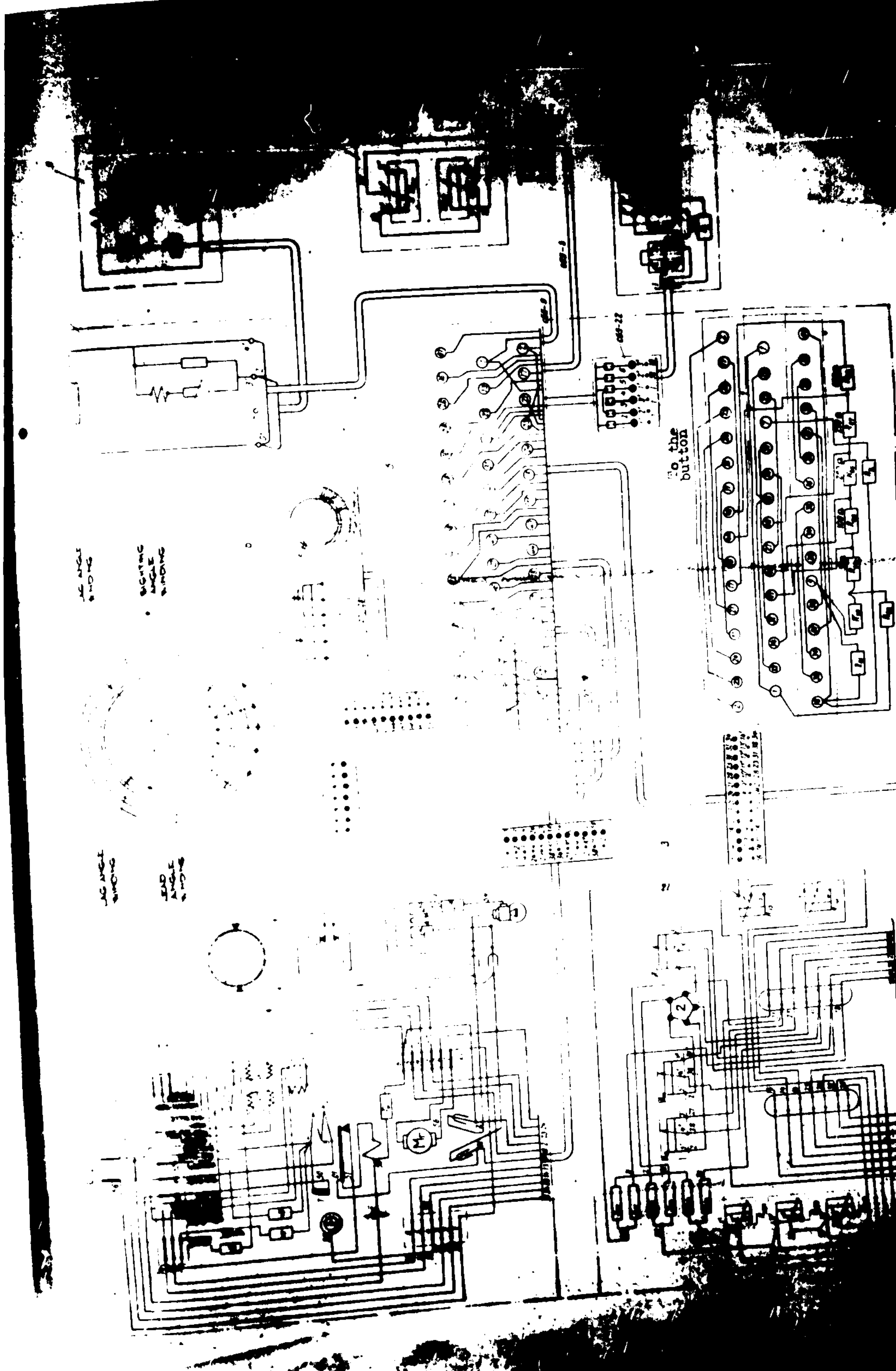

FIG 76 WIRING DIAGRAM OF THE SIGHT WITH THE ELECTROMAGNETIC LIFTING

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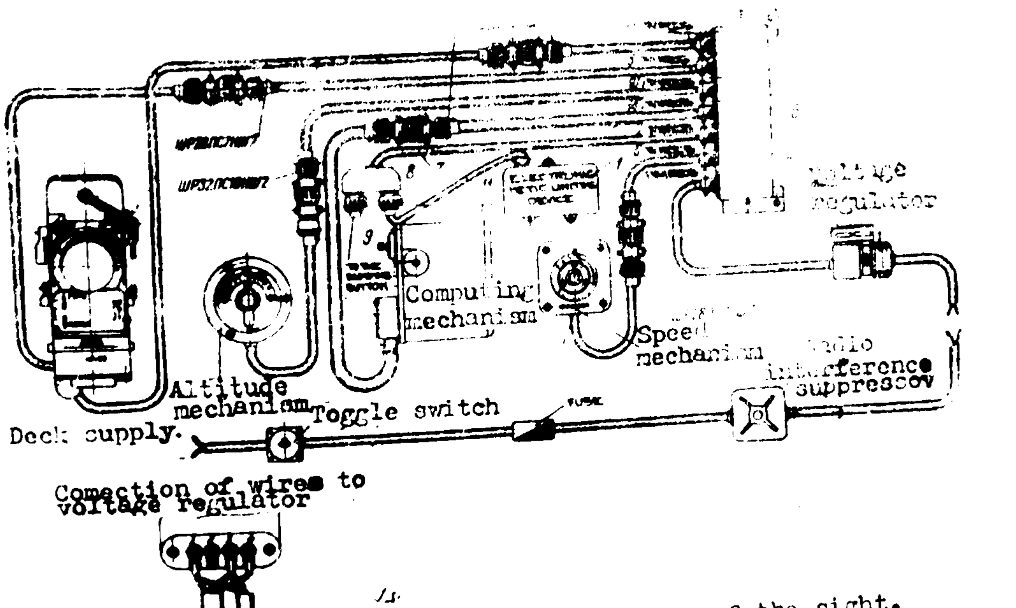
Junction box.

The junc[illegible]
units of t[illegible]
cables. At[illegible]
the unit,w[illegible]

Fig. 77. Junction box.

1- body ; 2- carbolite terminal strip ; 3 - clip ;
4- cable "Sighting head" ; 5- cable "Rheostat" ;
6- altitude cable ; 7- cable "Computing ";
8- cable "Button" and "Electromagnetic limiting device";
9- cable"speed" ; 10 - cable to the voltage regulator.



... of installation of the units of the sight.

Twelve - pin connector of cable 4, marked "Sighting head" is connected with the connector of the sighting head cable.

Seven-pin connector of cable 5, marked "Rheostat, is connected with the connector of the range rheostat cable.

Ten-pin connector of cable 6, marked "Altitude", is connected with the connector of the altitude mechanism cable.

Fourteen-pin connector of cable 7, marked "Computing", is connected with the connector of the computing mechanism cable.

The four-core cable 8 is connected with the transition socket which has two three-pin sockets marked "Button" and "Limiting device", to which are connected the connector of the damping button and the connector of the cable of the limiting device respectively.

Seven-pin connector of cable 3, marked "Speed", is connected with the connector of the speed mechanism cable.

Cable 10 is connected with the voltage regulator.

Supplement.

DESCRIPTION OF THE DEVICE P-3P FOR CHECKING THE SIGHT.

1. Definition and purpose.

The device P-3P for checking and repairing the sight consists of tube and a switch. The contrivances P-1 - optical tube, and P 2 - switch, are intended for a complete check-up of ASP-3P under operating conditions without removing the sight from the turret. They permit with a suffiuient degree of precission to check the main characteristics of the instruments: precission, condition of the circuits of the angles Ψ', angles of lag Ψ_{II}', Ψ_{I}' and angles (μ).

Apart from this, the switch permits the checking of the propper functioning of the sight by measuring the intensities of currents in main electrical circuits. For more detailed and more accurate tests, as well as for carrying out special repairs, the sight has to be dismounted from the turret and checked on the test-stand SPP.

CONSTRUCTION OF THE DEVICE.

a) Optical tube.

The optical tube consists (Fig.79) of a tube with a ball and socket joint 1, carrying the objective 2, the reticule and the eye piece 4.

Fig. 79

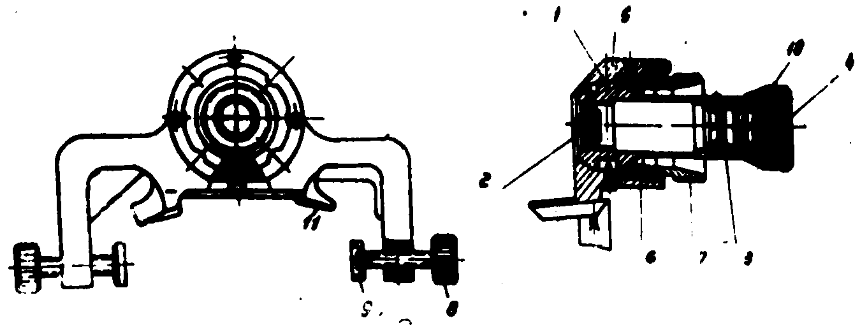


Fig. 79. Optical tube

The tube with the ball is fitted into a spherical recess of the bracket 5. A collar 6 tightened by a nut 7, is screwed into the bracket 5, for holding the tube in position.

The reticule has cross-hairs with scales marked in degrees. The value of the smallest division corresponds to 5.' It carries in addition two circles with angular values of their radii of 1° and 3° respectively. The total field of vision of the tube is 10°.

The bracket is fastened on the sighting head of the instrument with screws 8, with the pressure discs 9. When adjusting the tube, see that the heels 11 of the bracket 5 rest properly without rocking against the lugs on the sighting head body.

For adjusting the cross-hairs of the reticule to coincide with the centre point of the sighting head, proceed as follows :

a) loosen nut 7 by half a turn
b) set the knob of the switch to the position "Lead" ;
c) set the range D = 180 ;
d) by inclining the tube adjust the cross-hairs to coincide with the centre point of the sighting head ;
e) adjust correct horizontal and vertical position of the cross hairs by turning the tube in its ball and socket joint ;
f) retighten the nut 7 carefully.

If the reticule is out of focus, it can be brought into focus by revolving the mount 10 of the eye glass.

b) Switch.

The construction of the switch permits the checking of sights both

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with and without electromagnetic limiting devices. In the sight with the electromagnetic limiting device the cable, going from the gyroscope, has a connector with 12 pins, the one without the device with 10 pins. In the basic circuit of the switch the checking of sights with the electromagnetic limiting device is foreseen. For checking a sight without the electromagnetic limiting device it is necessary to employ an adaptor cable that is part of the equipment.

The switch (Fig.80) is mounted in a box, the top plate of which carries :

1 - knob of the switch ;
2 - engraved dial marked with the following checked parameters: "Lead", Vert.lag", "Sight", Horiz.lag", "Procession" (upper scale) and the number of the leads 10,24,14,34 (lower scale) ;
3 - Two position switch - "Checking of bridges" and "Checking of currents ";
4 - sockets "A" for connecting milliammeter ;
5 - sockets "V" for connecting voltmeter ;
6 - cable with the terminal plate ŠR32PSL2NŠ3 for connecting with the insert of the connector "Sighting head" from the junction box;
7 - cable with an insert ŠR32PS12NŠ3 for connecting with the terminal plate of the connector "Sighting head" from the sighting head.

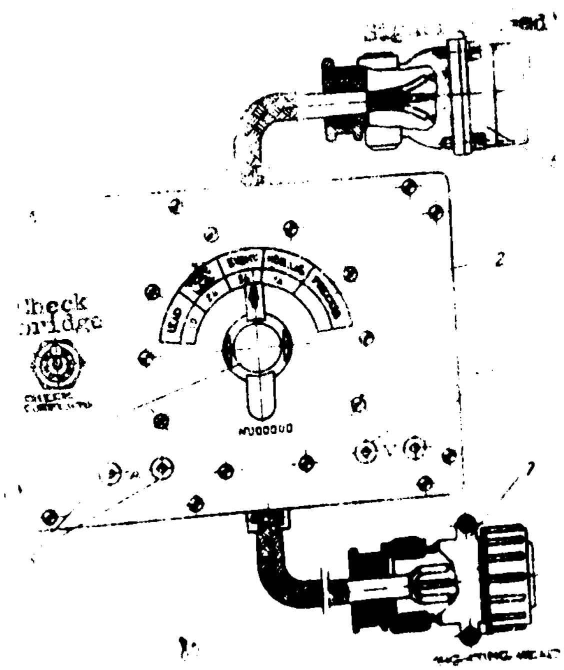

Fig.

with and without electromagnetic limiting devices. In the sight with the electromagnetic limiting device the cable, going from the gyroscope, has a connector with 12 pins, the one without the device with 10 pins. In the basic circuit of the switch the checking of sights with the electromagnetic limiting device is foreseen. For checking a sight without the electromagnetic limiting device it is necessary to employ an adaptor ca... ...equipment.

The switch ... two plate...

carries : 1 -

2 -

3 -

4 -

5 -

6 -

7 -

Fig. 80. Switch.

with and without electromagnetic limiting devices. In the sight with the electromagnetic limiting device the cable,going from the gyroscope,has a connector with 12 pins, the one without the device with 10 pins. In the basic circuit of the switch the checking of sights with the electromagnetic limiting device is foreseen. For checking a sight without the electromagnetic limiting device it is necessary to employ an adaptor cable that is part of the equipment.

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3 - Two position switch - "Checking of bridges" and "Checking of currents ";
4 - sockets "A" for connecting milliammeter ;
5 - sockets "V" for connecting voltmeter ;
6 - cable with the terminal plate ŠR32PSL2NŠ3 for connecting with the insert of the connector "Sighting head" from the junction box;
7 - cable with an insert ŠR32PS12NŠ3 for connecting with the terminal plate of the connector "Sighting head" from the sighting head.

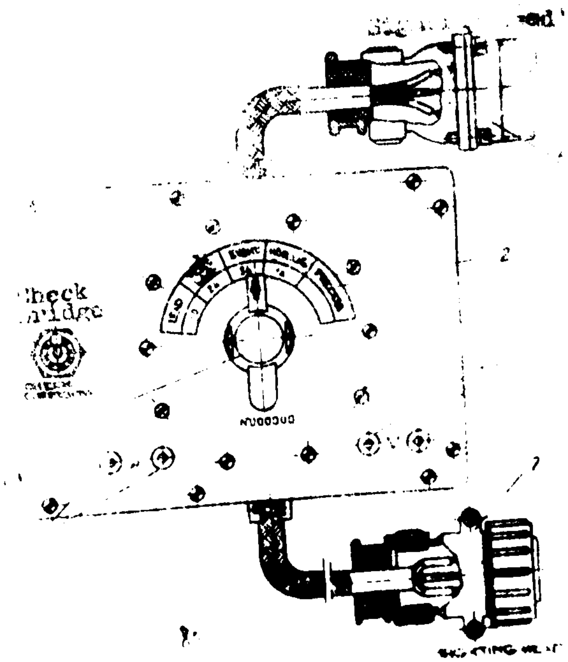

Fig.

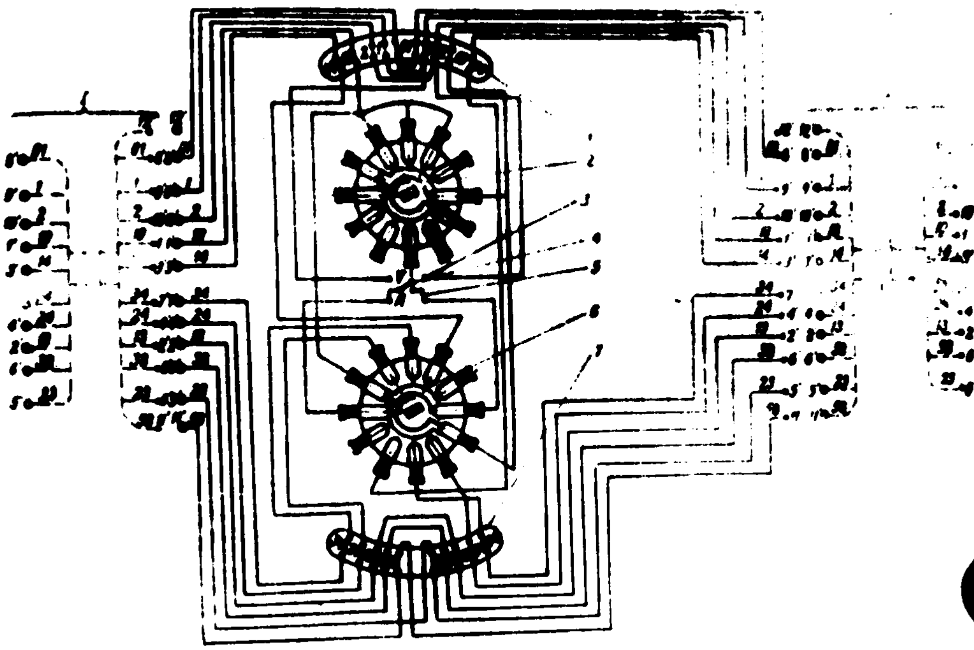

Fig. 81. Wiring diagram of the switch.

The switch is completed with two adaptor cables for checking the sights,whose connector "Sighting head" has 10 contact pins (the sight without the electromagnetic limiting device).

The wiring of the switch is shown by the wiring diagram (Fig.81) where: 1- and 7 are terminal strips

2- and 6 banks of the switch ;

3- sockets for connecting the voltmeter ;

4- switch for switching to "Check Bridge" and "Check current";

5- sockets for connecting the milliammeter ;

I- adaptor cable for checking sights without the electro-magnetic limiting device.

3) PROCEDURE FOR CHECKING THE SIGHT BY MEANS OF THE CHECKING DEVICE.

The sight is checked without it being removed from the turret. All motions of the sight are carried out in the turret IL-K6.

For checking the sight it is necessary to disconnect the cable marked "Sighting head" and to connect the units marked "Sighting head" the connectors from the switch. In case the connector of the cable

"Sighting head" has 10 pins (in sights without an electromagnetic limiting device), adaptor cables have to be used.

The optical tube is attached to the sighting head in front of the deflector and is tightened with the two screws. When adjusting the tube we must see, that the heels of the bracket sit properly without rocking on the lugs of the sighting head before adjusting cross-hairs of the tube to coincide with the centre mark of the sight proceed as follows:

1) set the switch on the cover of the box to the position "Check Bridge" ;
2) Adjust the voltage to 27 ± 10% ;
3) switch on the toggle switch ;
4) after a period of 15 minutes check the stabilised voltage which must be 22 V. If necessary adjust the voltage with the adjusting screw RVU. The voltage is checked at the socket "V" with a portable voltmeter ;
5) set the switch to the position "Lead" ;
6) set the arresting lever to "Gyro". The dial of bases should be set to 15 - 20 ;
7) adjust the range drum of the sight to D = 180 ;
8) adjust the cross-hairs of the reticule to the centre point of the sight ;

When using the tube, it should be remembered that its optical system gives an inverted image (left to right and top to bottom).

a) Checking the correctness of the circuits of the angles

Set the switch to the position "Lead". Turning the turret horizontally make sure that the gyroscope is not loose and forms the angles γ, the value of which changes according to the change in the angular speed of the turning sighting head and the adjusted range.

For an accurate check of the angles γ it is necessary to test the instrument on a special test stand of the type SPP.

b) Checking of angles of vertical lag.

Set the switch to the position "Vert.lag". The instrument is turned vertically down through 30° and horizontally to the left and to the right through 60°. The altitude mechanism control is set to the position "1000" and the speed mechanism control to the position "900".

Adjust in accordance with tab.1 different values range on the range dial of the sighting head ; read deviations of the centre point of the sighting head grid from the cross-hairs of the tube and compare them with the values in the table. The centre point should deviate from the cross-hairs down-wards and when turning the sight up-wards through 30°, the centre point should deviate from the cross-hairs up-wards.

T a b l e 1.

	Vertical lag angles		
Range	400	600	800
Vertical lag	32′	50′	1°09′
angles tolerance	± 20′	± 20′	± 20′

c) Checking the angles.

Set the switch to the position "Sight". Turn the sighting head upwards through an angle of 30°, for zero position horizontally. The position of the altitude and speed mechanism controls is not considered. Adjust the range on the range dial according to the values given in the table 2 and compare the angles + as measured on the reticule with the values, given in the table (Tab.2). The centre point of the sighting head should deviate from the cross hairs upwards.

T a b l e 2.

	Angles		
Range	400	600	800
Angles	18′	27′	31′
Tolerance	± 10′	± 10′	± 10′

d) Checking the angles of horizontal lag.

Set the switch to "Horiz.lag". Turn the sighting head through an angle of 30° to the left or right. The position of the head in the vertical direction is not altered. Set dial of the speed mechanism to "900" and that of the altitude mechanism to "1000".

Adjust the range drum in accordance with table 3 and measure the horizontal lag angles on the reticule of the tube. Compare with the data given in the table. When turning the sight to the left, the centre point of the sight should deviate to the left and vice versa.

TABLE 3.

Horizontal lag angles.

Range	180	400	600	800
Horizontal lag angles	38′	$1^{0}03$′	$1^{0}39$′	$2^{0}17$′
Tolerance	± 20′	± 20′	± 20′	± 20′

e) Checking the correct functioning of the altitude and speed mechanism.

In order to check the correct functioning of the altitude and speed mechanism, set the switch to "Horiz.lag", and turn the sighting head to the left through 30° and vertically in the zero position. Set the range drum to "800".

Set the altitude and speed controls to different values of altitude and speed as given in tab.4. Read off the deviation of the centre point from the cross-hairs and compare the values obtained with those given in the table. The centre point should shift to the left. If for increasing settings on the speed dial the centre point moves from the centre point of the cross-hairs to the left (angles increasing), while for increasing settings on the altitude dial the centre point moves towards the centre of the cross-hairs (angles decr[illegible] these mechanisms function correctly.

Table 4.

Speed \ Altitude.	1000	4000	10000
300	46′	32′	16′
600	1^{0} 31′	1^{0} 04′	32′
900	2^{0} 17′	1^{0} 36′	48′
Tolerance	± 20′	± 20′	± 20′

If during the checking of the correct functioning of the sight carried out according to sections 1,2,3,4, and 5, all the parameters are within the limits of the data, given in the tables the sight functions correctly.

f.) Checking the procession movement.

Set the switch to "Horiz.lag" and by means of the range control at the same time. Turning the sighting head along the horizont, adjust a deviation of the centre point to 4,5°. It is recommended to turn sighting head by revolving the whole turret by hand. Quickly switch from the position "Horiz.lag" to the position "Precession" and measure by means of a stopwatch the time needed for the passage of the centre point while returning towards the centre of the cross-hairs from the 4° to the 2° divison of the reticule.

The time of displacement must not be less than 7 sec. If the time is within the tolerance, the gyroscope is in order.

4. CHECKING THE CORRECT FUNCTIONING OF THE SIGHT BY MEASURING THE CURRENTS IN THE COMPUTING - CIRCUITS.

The checking of the electric computing part of the sight, the electric circuit for the angles (angles β Ψ Ψ_v) can also be performed with the switch P2 and a milliammeter. The checking is performed as follows:

The checking,dealtwith in this chapter,is subsidiary and is performed from time to time for checking the circuit elements. The main checks of the functioning of the sight is performed in the manner dealt with in previous chapters.

1) Set the switch 3 (Fig.90) to the position "Check Current".

2) Set switch to the position 1o (on the lower scale).

3) Measure the inputs to the sight for the wire 10 accordings to the data in the table of currents given in the certificate.

4) Connect the milliammeter (standard of precision at least 1,5 with scales 0 - 500 mA and 0 = 50 mA) and measure the current in the circuit 10 ("Lead") taking the readings on the 0-500 mA range of the meter.

The measured currents is determined as an average of at least three readings with accurately adjusted input data and with a constant input voltage of 22 V.

Measure the currents in the other circuits in a similar manner always adjusting the values given in the table for checking the current. If the measured current is within the limits given in the table, then the computing circuits of the sight are in proper working order.

Sights,produced recently,have another table in their certificates, which contains concrete values of the currents measured in the factory. If the measured currents differ from those given in the table less than ± 25 mA for the circuit of the wire 10 and by less than ± 6 mA, in the circuits of the wires 34,24,14 the circuits are taken to be in proper working order.

N O T E :1) If the milliammeter is not of the mentioned standard of precision, the current measurement can be performed with a tester, however, as a result of the lower standard of precision of the tester the tolerances for the values of currents will be corresponding greater.

2) If the current in any of the circuit tested surpasses the limits of the given tolerance, the instrument has to be dismounted from the turret and checked on a test stand of the type SPP.

The measurement of the currents, referred to in the table, are performed in the factory in a temperature range of $t = +15 + 25^{\circ}C$, 10 - 15 minutes after switching on the sight. It is recommended therefore to check the currents under identical conditions. If the currents are measured at other temperatures, or after a considerably longer time of operation of the sight. they can naturally differ owing to the temperarure dependance of measuring instruments and of circuits of the sight itself.

T A B L E 5.

Checking of the currents in the circuits of the sight

No. of wire in the junction box in which the current is measured.	Input data x/					Nominal value of current in
	D	q	E	H	V	
10	180	xx/	-	2000	-	from 290 to 390
34	800	-	0°	5000	900	" 10 " 45
24	800	0°	60°	1000	900	" 15 " 35
14	800	70°	0°	4000	900	" 10 " 25

x/ D- value of range on the dial of the sight

q - deck angle

E - angle elevation

H - value of altitude on the altitude mechanism dial

V - value of speed out columns the position of mechanism is of no consequence.

5. CHECKING OF DIAMETER (γ) OF VARIABLE CIRCLE.

By means of the optical tube P-1 it is also possible to check the diameter of the variable diameter circle of the grid. For this purpose make the centre of the cross-hairs coincide with the centre point of the grid and adjust different values of the base and of the range on their respective dials accordings to table 6. Measure the diameters of the variable diameter circle of the sight on the reticule of the tube. The diameter of the circle is measured on inner ends of the rhombs. If the measured values are within the tolerances given in table 6 the dimension of the variable circle is in correct dependance on the base and the range.

TABLE 6.

Diameters of a variable circle (γ) of the grid

Base	9	13	13	26	31	26	31
Range	350	500	250	500	600	250	300
Tolerance $\pm \Delta\gamma$	6'			7'		14'	
γ	1° 26'			2°52'		5° 44'	

6. STORING AND CARE FOR THE DEVICE.

In order to avoid mechanical damges, the device is to be stored in a special packing case. It is categorically forbidden to throw the case or to turn it over.

For protection against corrosion, the device is periodically smeared and lubricated with ammunition grease, except for the pptics, laquered details and cables.

Oiling the contacts of the connectors is not permitted. Before using the device wipe the optical details carefully with a clean cloth.

LIST OF FIGURES.

C O N T E N T S